PRACTICAL SLIDE MAKING

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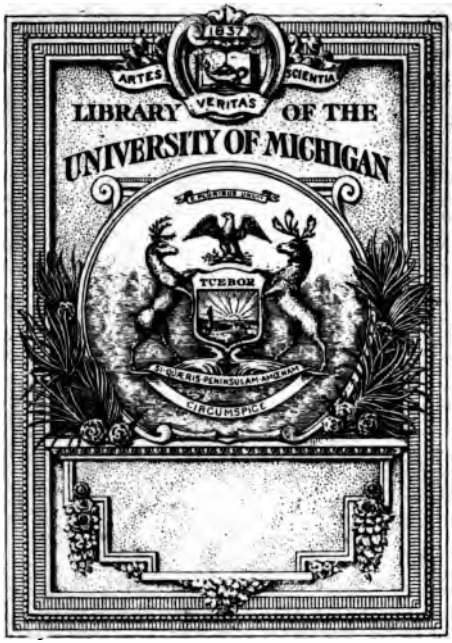
BY G. T. HARRIS



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By G. T. Harris, F.R.P.S.

Author of Practical Landscape Photography.

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PREFACE.

The best testimony we have of the permanent position held by the lantern slide is the perennial popularity it wins from photographic workers. Positive printing processes of one kind and another wax and wane in public favour, but there has been no time in the history of the lantern slide when it did not possess a firm hold on the photographic world.

The lantern slide is more in demand now than it ever was. Lecturers illustrate their travels by the aid of it; educationalists find in the lantern slide an invaluable means of supplying illustrations to their remarks; while the social proclivities of the lantern slide eminently fit it for the purposes of the recreative worker.

The aim of the present small volume is to supply in a concise form reliable information of all the best known methods for the production of lantern slide transparencies. At the present time many excellent lantern slide processes have fallen into desuetude and are seldom heard of, but it is hoped that their inclusion here will lead to enthusiastic workers resuscitating them on their own behalf. To

this end special care has been exercised in the preparation of the chapters dealing with such neglected processes as collodion (wet and dry) and collodio-albumen, in order that anyone who may be tempted to use them can at the outset be in possession of reliable formulæ.

G. T. HARRIS.

London, February, 1904.

CHAPTER I.

INTRODUCTION—AIM AND SCOPE OF THE BOOK—WHAT A LANTERN SLIDE IS—CONTACT VERSUS REDUCTION—MAKING A SLIDE BY CONTACT—DEVELOPER FOR BLACK COLOURS.

THE object of this book is to place before the slide worker a general review of the standard processes for the production of slides, with descriptions of reduction and contact methods, and details of such accessories as may be deemed most useful to the general worker. For the benefit of those who have yet to make their preliminary trials in lantern-slide work, the subject will be treated *ab initio*, without assuming even an elementary knowledge of the process on the part of the beginner. Later on processes will be described that appeal more directly to the advanced worker and to the lantern-slide enthusiast; processes that are viewed by many simply with historical interest, and yet which are capable of giving the finest results when facility in their working has been acquired. Albumen, collodio-bromide, wet collodion are processes that few modern slide-

makers connect with lantern transparencies, yet for downright quality no modern process can claim superiority over the time-honoured albumen, and slides of Ferrier's of thirty years ago hold their own when compared with the best work of to-day. Wet collodion, in capable hands, is still the process *par excellence* for obtaining crisp, bright results with a minimum expenditure of time and trouble, and collodio-bromide has the merit of having fixed a standard of excellence for the modern gelatine lantern plate.

A question the beginner in lantern-slide work will most probably ask himself is, "What constitutes a lantern slide?" He is, most probably, already in possession of the fact that, in the negative he has taken, the lights and shadows of the original are reversed, and that to obtain them as they existed in the original it is necessary to get from the negative a print which gives the lights and shadows of the original as they were seen by the eye. This "positive" print on paper will be viewed by "reflected" light, *i.e.*, by light reflected to the eye from its surface. If the gelatine film of a P.O.P. print were stripped from its paper support the "positive" image would be seen to exist in this film, but as there was no longer any white background paper to reflect the light through this image it could not be seen as a positive. Suppose this film were now laid upon a clean piece of plain glass and pressed firmly and evenly into contact with it, on

being held up between the eye and a clear view of the sky the positive appearance would be restored and the picture would again be seen as plainly as when it was supported on the white paper. The film, in fact, has now become a lantern slide, but instead of being made apparent to the eye by light *reflected from* the white paper support, the eye sees the picture by light *transmitted through* the film from the background of the sky. It will be obvious, then, that fundamentally there is no difference between the paper print and the lantern slide, but that the one is, for convenience, placed upon a white paper support, while the necessity for using transmitted light in the optical lantern demands that for a lantern slide the image-bearing film be borne upon a transparent support.

It follows from what has been said that lantern slides can be printed from the negative in just the same way as an ordinary silver print, provided that the same sensitive material is used upon glass instead of upon paper; the image could afterwards be toned and fixed as though it were a paper print. At one time considerable lantern-slide work was done in this manner, as the image, becoming visible during printing, offered facilities for modifying it, not available when the image required developing. The inconvenience of using an inflexible support in the printing frame, which prevents a ready view being obtained of the depth of the print, coupled with the slowness of the process, debarred it from attaining

any permanent popularity. At the present time lantern slides are produced almost exclusively on the lantern plates of commerce.

The exposure of a lantern plate may be either by "contact" or by "reduction." Suppose the worker employs a quarter-plate hand camera for taking the negatives, he can make his lantern slides by placing the negative in the printing frame as used for paper, adjusting his lantern plate upon the negative, film to film, closing the frame and exposing to gaslight for the necessary time. In this case he is working by "contact," and as the size of a lantern plate is $3\frac{1}{4} \times 3\frac{1}{4}$ inches, while the quarter-plate is $4\frac{1}{4} \times 3\frac{1}{4}$, it follows that, when working by "contact," some portion of the original negative has to be omitted.

It is frequently the case that when working from hand camera negatives some portion of the original negative can be omitted without detracting from the value of the picture, but where larger sized plates are used, half-plates and upwards, contact printing is out of the question unless some very small portion of the original is desired. When it is desirable to make lantern slides from negatives which are of much greater dimensions than the lantern plate, the slides are got by reducing the original size of the negative, by means of the camera, until it shows on the focussing screen the same size as the lantern plate. A lantern plate being placed in the dark slide and exposed to this image will result in a lantern slide that embraces the whole of the subject

that is in the larger negative. This constitutes the method of work known as "reduction." Later on full descriptions of these two methods of working will be given, with the apparatus necessary in each case.

Some workers of experience contend that finer results are got when making slides by reduction, even in the case of quarter-plate negatives. I am inclined to think that such is the case, though the gain in quality is not sufficiently striking to impress a beginner.

One decided advantage camera reduction has over contact printing is that, should any unevenness be present in the surfaces of either negative or lantern plate, the definition is not impaired. "Contact" printing is certainly the simplest form of exposure for the beginner, and as it can be conducted without any special apparatus, as it is entirely independent of daylight, and with some lantern plates, even of the customary darkroom, it is the method that will receive the first consideration in this book.

Before commencing any descriptions of the methods whereby lantern slides are made it may be well to caution the beginner against depriving himself of sufficient light in the dark room. The sensitiveness of lantern plates is so greatly inferior to that of plates used for negatives that it will take the beginner in lantern slide work some time before he acquires the courage to use all the light permissible

with these slow plates. Some lantern plates are so slow that they can be manipulated in the light of a naked bat's-wing burner, if it be turned down, and the plates are not exposed unnecessarily to its light. With the ordinary lantern plate, made for reduction and contact work, the light of a paraffin lamp screened by two thicknesses of canary medium will give a light that is both safe and comfortable. It is convenient to have between the fabric and the lamp burner a sheet of finely ground glass which affords a very pleasant diffused light whereby to judge the density of the slide. It is convenient, also, on taking the slide from the fixing bath to raise the cherry-coloured fabric and have the greyed surface to examine the slide by.

The negative for contact printing, which will probably be of quarter-plate size, can be placed in a quarter-plate frame such as is used for paper printing; it is carefully dusted with a broad camel-hair brush to remove anything that might injure the film of the lantern plate. This latter is then placed upon the negative, the film of the lantern plate against the film of the negative. The lantern plate should not be slid into position over the surface of the negative or damage to the film may result; it should be placed deftly in the position it has to occupy without any need for readjustment when laid down. The back of the frame should be placed in position and fastened by the springs. It must be remembered that the thickness of the lantern plate

will cause considerable pressure if the felt pad used in paper printing is employed here also, and usually quite enough pressure to ensure contact will be got without using the pads.

Having fixed the lantern plate in the frame it now requires exposing to light. Daylight is practically out of the question, as, in spite of the relative slowness of these plates, they are still sufficiently rapid to make daylight exposures unmanageable.

The most convenient light is a gas burner, and if it has a bypass, exposures can be readily made in the dark room without loss of time.

We must bear in mind the fact that in lantern slide work long exposures give warm coloured slides (the developer being suitably adjusted) and short exposures black tones. Suppose five seconds' exposure at a given distance from a bat's-wing burner gives a lantern slide of black tone, then with half a minute's exposure at the same distance the slide will have a brown colour, and with a minute's exposure the colour will be decidedly red. The developer would require modifying in each case to suit the increased exposure. Producing satisfactory warm tones in lantern slides, at the same time retaining other desirable qualities, demands more experience than making a slide having a black colour, and such being the case the beginner is recommended to adhere to the production of black coloured slides until he can make them with ease and certainty.

AN AMIDOL DEVELOPER.

A negative of medium density, held about eighteen inches from a bat's-wing burner, would require an exposure of some six seconds for black colours, when the ordinary lantern plate was used, and developed with the formula given below:

Amidol	20	grains
Sodium sulphite	240	,,
Potassium bromide ...	10	,,
Water	10	ounces

Development is very rapid, much more rapid than would be the case with a negative, and the beginner has to be on his guard against obtaining excessive density. The exposure must be so timed that when development is complete the highest lights of the picture have no veil over them; this can readily be seen after the plate has been fixed if the slide be laid upon a sheet of white paper. The paper should show through the high lights perfectly white, otherwise a crisp picture, when the slide is projected upon the sheet, cannot be hoped for. As soon as density has been obtained in the developer the slide is placed in the fixing bath, made as follows:

Sodium hyposulphite ...	2	ounces
Sodium bisulphite ...	½	ounce
Water	10	ounces

This is a brief description of the making of a lantern slide, and the beginner is recommended to persevere with the above simple method until he can produce slides of good quality before undertaking the more difficult work of obtaining warm tones and making slides by reduction.

CHAPTER II.

MAKING LANTERN SLIDES BY REDUCTION ON COMMERCIAL PLATES—DESCRIPTION OF THE APPARATUS FOR USE WITH DAYLIGHT—TABLE OF CONJUGATE DISTANCES—REDUCTION BY ARTIFICIAL LIGHT—FIXED FOCUS CAMERA.

IN the previous chapter a very elementary description was given of the production of a lantern slide with the aid of a printing frame. The method given would scarcely satisfy any but a beginner anxious to produce a lantern slide without venturing too far into the intricacies of the subject. Complications and refinements are sure to attract the worker before long, the printing frame will be discarded for the camera, and the black colours gradually give way to warmer ones. To anticipate the desires of the worker, it will be desirable to devote the present chapter to the description of some arrangements for producing lantern slides by reduction with a camera, involving the use of both artificial light and daylight.

It was remarked earlier in these chapters that for any negative larger than quarter-plate it was essential to resort to camera reduction for producing lantern slides if the whole of the subject was wanted in the slide. The opinion may also be hazarded that as the lantern-slide worker becomes more competent he will incline more and more towards camera

work as a means of slide making. Some processes for making lantern slides, though giving most excellent results, are too slow to permit of exposures in the camera, and one is compelled to reserve them exclusively for contact use, but in the case of a plate like the lantern plate of commerce, which is available either for contact or reduction, the camera will be found to be the most satisfactory means of obtaining a lantern slide. Even in the case of quarter-plates, which have been taken with a lens of fairly long focus, it is seldom that the slide would not have been the better for the inclusion of the whole of the subject.

The camera for use in making slides by reduction may be the ordinary field camera if it is of the "stand" camera pattern, but where lantern-slide work is followed systematically it is most desirable to have a camera relegated to the work of lantern-slide production. The arrangement shown in fig. 1 (page 21) is that which is used by the writer; it is simple in construction, and does all that is required in making lantern slides by daylight reduction. It consists of a baseboard about four feet long and one foot wide; between two parallel guides running the whole length of this baseboard slides a block of wood the same size as the base of the camera, and having a ledge at either end to hold the camera firmly. A negative holder, with carriers for various sizes of negatives, slides at the other end of the baseboard, and the whole enables lantern slides to

be obtained from negatives 15in. by 12in. down to 4¼in. by 3¼. . The camera used on the base-

Fig. 1.

board is a square half-plate, but, of course, any camera can be adjusted for use in a similar manner.

REDUCTION BY DAYLIGHT.

A very convenient instrument is one of the square sliding-body cameras made for wet-plate work, which might be bought for a few shillings. If a camera of this description is permanently affixed to the block sliding between the parallel guides it makes a most efficient camera for lantern-slide reduction.

The lens used should not be of very long focus, or the exposures will be inconveniently protracted. Four and a half inches is a convenient focal length, and although a single landscape lens is permissible, it is better to use a lens of the rapid rectilinear form to avoid any possibility of distortion.

It will be seen from the illustration that the whole arrangement is inclined so as to command a clear view of the sky. If it is possible to exercise any choice, a northern aspect should be selected, as then no trouble is experienced from sunlight striking the negative. Should a north or north-eastern aspect be unobtainable, or should such objects as trees and chimneys project into the field of view, it is convenient to cover that part of the window used with one or two thicknesses of tissue paper, or, which is even better, a single thickness of white demy paper. Two rods are shown in the illustration connecting the camera and negative holder; these are simply loose rods laid across to bear the focussing cloth, which is thrown over previous to exposure, to make a dark chamber between the lens and negative—a precaution that prevents any diffused light operating on the negative from the rear. Using the arrange-

ment here shown for daylight exposures, with a four and a half inch lens and f/16 stop, the exposures

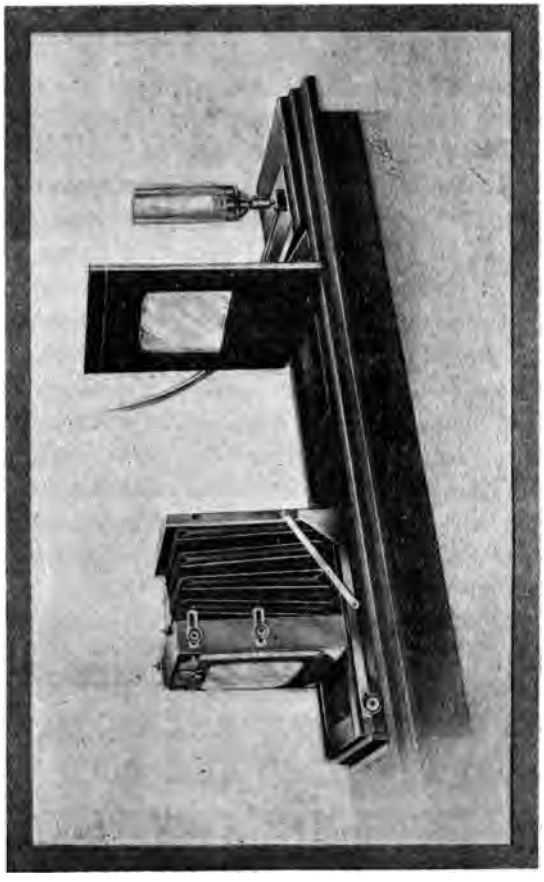


Fig. 2.

with ordinary lantern plates will be about twenty

seconds for black colours and up to three minutes for warm colours, the negative reduced being a half-plate, and the light outside good, diffused spring light.

It would be impossible here to go into the question of conjugate foci, so intimately associated with all matters of enlarging and reduction. The better plan for the beginner is to arrive at the correct distances that are necessary between the lens and plate on the one hand, and between the lens and negative on the other, by a system of trial and error, remembering that the greater the reduction the further the negative has to be from the lens, and the less camera extension needed. Once the correct distances have been found, marks made on the baseboard for the positions of the camera and negative holder will enable them to be speedily adjusted on all subsequent occasions. As a rough guide for preliminary trials, the following may be of assistance to the beginner:

Focus of lens.	Half-plate negative to 3¼ x 3¼.	Whole-plate (8½ x 6½) to 3¼ x 3¼.
3½ inches	14 inches negative from lens 4½in. screen from lens	21 inches negative from lens 4 inches screen from lens
4½ inches	18 inches negative from lens 6 inches screen from lens	27 inches negative from lens 5½ inches screen from lens
5 inches	20 inches negative from lens 6½ inches screen from lens	30 inches negative from lens 6 inches screen from lens
6 inches	24 inches negative from lens 8 inches screen from lens	36 inches negative from lens 7 inches screen from lens

Reduction in the camera by the aid of artificial

light is quite easily accomplished in the absence of daylight, and the majority of lantern-slide workers will find artificial light more convenient, as work can be carried on in the evening. Fig. 2, page 23, will give a good idea of the plan adopted by myself. The apparatus is that used in daylight reduction so far as the baseboard and camera are concerned, but it is, for convenience sake, used horizontally upon a work bench. Two Welsbach burners constitute the source of illumination (one only appearing in the illustration), and the light is diffused by passing through two thicknesses of tracing paper placed over the negative holder. The burners require adjusting at a sufficient distance from the tracing paper to give even illumination, and to this end they are fixed on a sliding stand.

The lens for use with artificial light should have as short a focus as possible to secure the maximum amount of illumination. A 3½in. rectilinear is very convenient if of good quality, so as not to require stopping down before definition can be obtained.

In place of the Welsbach burners an arrangement may be substituted for burning magnesium ribbon, or a flash lamp. The burners, however, are by far the most reliable illuminant. Magnesium ribbon is most convenient for contact exposures with very slow plates, but for reducing purposes its use is attended with some degree of uncertainty.

The simplest way of camera reduction when the negatives are all of one size is to use a "fixed-

focus camera" (fig 3). A rectangular box of the size of the negative to be reduced has provision made for holding the negative at one end. At the oppo-

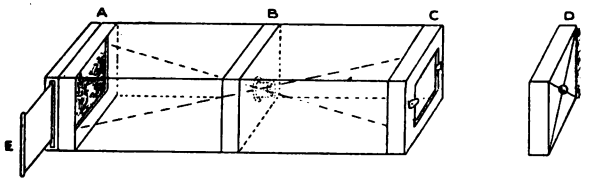


Fig. 3.

site end of the box is a frame with 3¼in. by 3¼in. aperture, into which a lantern plate is placed and held in position by a spring, a light-tight lid fitting on the end of the box. The lens is fixed near the middle of the box in a rigid frame, in the position to focus accurately upon the lantern plate. All that is necessary is to place the negative in position at one end of the box and a lantern plate at the other, to cover up both ends until the apparatus has been illuminated, and then to expose by removing the cover of the negative.

It will be seen that this method of work has very serious limitations. Should it be necessary to enlarge slightly the image so as to exclude from reproduction some unessential portion, the camera fails utterly. Nor is it possible to use it for any other size than that for which it has been made.

Printing by "contact" necessitates little apparatus beyond the ordinary printing frame as used for

paper prints. Ingenuity has been expended in devising printing frames specially for use in lantern-slide work. They are convenient when a slide is printed by contact from some portion of a negative very much larger than the lantern plate. But the slide maker may be content with an ordinary printing frame, merely putting underneath the negative a piece of plain glass the size of the frame for the negative to rest upon. By so doing no danger of fracturing the negative from the unequal pressure of the lantern plate need be feared.

CHAPTER III.

PRODUCING LANTERN SLIDES ON COMMERCIAL PLATES—VARIOUS COLOURS IN SLIDES—THE PRODUCTION OF BLACK COLOURS—DEVELOPERS FOR SUCH—ACID FIXING BATH—DEVELOPERS FOR WARM COLOURS.

AT the presnt time nearly the whole of the lantern slides produced by the vast army of lantern slide workers are made on commercial plates. Their convenience and excellence have won for them an impregnable position in public favour, which is not without justification.

The colours obtained upon the ordinary commercial plate range from an admirable black through browns to red, and even purple, should anyone have a taste for claret-coloured lantern slides. The classification of colours obtainable on a gelatine plate has been extended *ad nauseam*, and is often merely an individual statement of accidental results, the "rich sepia" of one man being the "warm brown" of another, the ingenuity shown in framing formulæ to obtain these results having served to encumber the pages of photographic literature with a mass of recipes utterly bewildering to the uninitiated. The

colours most generally useful are black, warm black, brown, and warm brown.

To obtain any of these colours with certainty and to repeat the exact colour obtained upon one occasion at any subsequent time is not easy, and the slide maker will find that he is forced more or less to compromise by accepting considerable departures from any standard colour. Each worker, therefore, must adjust the developer to his own personal equation and method of working. The formulæ given in this chapter will be found to give the colours described with tolerable exactitude, but as the worker in lantern slide operations progresses he will most certainly modify any formula that comes into his hands to suit his own requirements.

Before proceeding to a detailed account of the development of gelatine lantern plates, it may be well to mention that colour in lantern slide work, more especially when made on gelatine plates, is almost entirely a matter of exposure followed by suitably-adjusted development. Any reducing agent —hydrokinone, metol, eikonogen, etc.—will give either warm or black-coloured slides if modified to suit the exposure. Short exposures in a strong light, followed by quick development, tend to the production of black colours, while long exposures, coupled with protracted development, result in colours more or less red. Bearing this in mind, one can make a rational application of any developer.

In connection with this point, it may be interesting to give the results of some experiments made by H. Liesegang, and published in the *Photographische Chronik:*

Colour.	Proportional exposure.	Concentration of developer.
Greenish black ...	1	1 to 5
Olive black	2	1 to 5
Sepia	3	1 to 10
Brown	4	1 to 10
Red brown	6	1 to 20
Yellowish brown ...	8	1 to 20
Red	5	1 to 30
Reddish	10	1 to 30
Yellow	20	1 to 40

Although these results were derived from a series of experiments on the development of silver chloride, they agree very closely with what the lantern slide worker finds to be the case with gelatine lantern plates, which, in fact, are largely composed of silver chloride.

The production of black colours in lantern slides calls for no special skill on the part of the worker; so long as he uses a clean, quick working developer and gives a short exposure, the rest is easy. In camera reduction, when working for black colours, the light outside, if daylight methods are used, must be sufficiently good to give a well-exposed plate with six to ten seconds' exposure; and when "contact" exposures are made, the illuminant is better

fitted for the production of black colours if it takes the form of an incandescent gas mantle. With such a light, and a negative of medium density held at a distance of about eighteen inches from it, the exposure need not exceed ten seconds. Any of the modern reducing agents will give black colours, but each one has a particular shade of black peculiar to itself.

For example, hydrokinone gives a black that often assumes a greenish hue, especially with caustic alkalies; metol is characterised by its bluish-black; and eikonogen has a very pleasing olive black. Amidol, in my opinion, gives the nearest approach to a pure black of any developer, though it is run very close by edinol.

It will be seen from a consideration of the above peculiarities what a considerable undertaking it would be to give formulæ embracing all the recently introduced developers, with their varying shades of colours. I shall content myself with giving here several simple formulæ, which are the sublimated results of many months' experiment among modern developers. Once the lantern slide worker has passed through his apprenticeship, he will find the field of modern developers extensive enough to afford him many months' work, and the results will be sufficiently varied to suit the most exacting.

AMIDOL DEVELOPER (for black).

Amidol	...	...	20 grains
Sodium sulphite	...	...	240 „
Potassium bromide		...	10 „
Water	...	...	10 ounces

Development is very rapid, but it is necessary to give a seemingly excessive opacity to compensate for the loss in fixing. Any "forcing" of development through under-exposure is to be carefully avoided in lantern slide work. The development should bring out the detail steadily through the various gradations, until the extreme high lights appear, and these should remain perfectly clear while the slide is acquiring sufficient opacity.

When development is judged complete, the slide is quickly placed without any washing in an acid fixing bath. It is a mistake to submit lantern slides to a washing process between development and fixing, as during the process the slide acquires sufficient density to cover the highest lights, that have been so zealously guarded. I am aware that many hands have been uplifted against the use of an acid fixing bath, and probably will continue to be raised until the end of the tale. My own experience is absolutely in its favour, and I have constantly employed it in the form given below for the last fourteen or fifteen years. For lantern slide work, I particularly recommend its employment. Fading, marks of any and every description, have at various

times been attributed to its employment, but in my fifteen years' experience I have never found either a negative or lantern slide fade, and I see no reason, if properly made, for an acid fixing bath to cause fading.

The bath referred to is prepared by dissolving in ten ounces of water one ounce of sodium bisulphite; in another ten ounces of water four ounces of sodium hyposulphite are dissolved; and then, while stirring, the bisulphite solution is poured slowly into the soda solution. When mixed, the formula will stand thus:

Sodium hyposulphite ...	4 ounces
Sodium bisulphite	1 ounce
Water	20 ounces

On removing the slide from the fixing bath and examining it before a piece of opal or ground-glass, it should appear "crisp," without any appearance of "inkiness" in the shadows, and when laid upon a sheet of white paper the extreme high lights should have the appearance of being bare glass.

AMIDOL DEVELOPER (for warm black).

Amidol	20 grains
Sodium sulphite	240 ,,
Ammonium carbonate ...	20 ,,
Potassium bromide ...	20 ,,
Water	10 ounces

The exposure for warm black colours when using the above developer will be about double the expo-

sure required for black, and development will be rather slower; it should not be carried so far, however.

When the production of warm colours is attempted with gelatine plates, it is better to adopt pyrogallol as the developer. Not that warm colours cannot be obtained with the modern reducing agents, but "pyro" and ammonia undoubtedly produce them with greater facility than do the others. The sub-joined formula has given in my hands very good browns with about five times the exposure needful for blacks. With some plates, to produce brown colours, it may be necessary to add more bromide.

PYROGALLOL DEVELOPER (for brown).

A.	Pyrogallol	30	grains
	Sodium sulphite	120	„
	Citric acid	3	„
	Water	10	ounces
B.	Ammonium bromide ...	40	grains
	Liquor ammonia (.880) ...	30	minims
	Water	10	ounces

Equal parts of each are taken to develop.

It will be noticed when developing for warm colours that the image develops in a manner very different from a black-coloured image. With black images the gradations appear crisply defined *on* the surface of the film, but with warm-coloured images the picture seems buried *in* the film, and is only seen when examining the plate by transmitted light.

This appearance is rather puzzling to the novice, and misleads him into giving greater density to the plate than is desirable. Only experience can enable him to judge when correct opacity has been reached, but he will find, where warm colours are in question, that a very small amount of *apparent* density will prove on fixing to have been ample.

The development of lantern plates in the production of warm colours is oftentimes a tedious operation, requiring perhaps ten or fifteen minutes, and there seems no way of curtailing the time and retaining at the same time the quality of image. Loss of time may be prevented by using a grooved tank and leaving the plates to develop while other exposures are being made. Development is so slow that over-development need never be feared. The temperature of the developer should never be below 65° F.

Should warmer colours than those given by the above developer be required, they may be obtained by adding to each ounce of the mixed developer twenty or thirty minims of a ten per cent. solution of ammonium carbonate. It has been stated, but not on sufficiently good authority, that the use of the carbonate causes fading. In place of adding the carbonate as a ten per cent. solution, it may be combined with the developer in bulk, in which case the following formula is a convenient one:

PYROGALLOL DEVELOPER (for warm brown).

A.	Pyrogallol	20	grains
	Ammonium bromide ...	20	„
	Sodium sulphite	120	„
	Sulphuric acid	25	minims
	Water	10	ounces
B.	Liquor ammonia (.880) ...	100	minims
	Ammonium carbonate ...	20	grains
	Water	10	ounces

Equal parts of each are taken to develop.

The formulæ given in this chapter will cover the whole field of the development of gelatine lantern slides. Success in lantern slide work is due not so much to any especial formula as to continued practice on the part of the operator. The production of first-class slides as regards crispness, colour, and exact density is not, in my experience, too easy of attainment, nor does there appear to be any "royal road" to such an end.

CHAPTER IV.

TONING SLIDES ON COMMERCIAL PLATES—TONING WARM-COLOURED IMAGES WITH SULPHOCYANIDE, PLATINUM, AND GOLD—TONING BLACK-COLOURED IMAGES WITH COPPER AND URANIUM BATHS—BATH FOR A GREEN COLOUR—REDUCING LANTERN SLIDES—INTENSIFYING THEM.

IN preparing to discuss the subject of toning lantern slides made on ordinary gelatine lantern plates, I must confess to having rather a decided bias against the operation. My opinion is that the finest slides are those in which the exact colour is obtained by development, and I believe experienced workers incline to the same opinion.

When toning lantern slides there is always some danger of the gelatine becoming stained by the toning agent; in which case the high lights, which should be absolutely transparent gelatine, have their original purity degraded by the ground colour of the slide. This fault is especially noticeable when toning slides with the uranium and ferricyanide toning bath. Unless very great care has been exercised a brown tint pervades the whole of the slide where clear gelatine should exist, due to the

toning agent having *stained* the gelatine at the same time that it toned the image.

Many, if not all, toning processes have, at the same time, a slight intensifying action, and this intensification makes itself unpleasantly apparent when the slide dries, as the shadows usually become very heavy, losing the transparency one usually finds in slides that have not been subjected to toning operations.

Slides will either be toned from a black to a warm colour, or *vice versâ*, and the most satisfactory results in toning are those obtained when a warm-coloured image is toned down towards black. If black images are toned to a very warm colour the decided change is often accompanied by loss of quality, due to the length of time occupied in toning, or to the strength of solutions employed.

To tone a warm-coloured image to darker colours, platinum, gold, sulphocyanide, and palladium may be employed; while, to tone a black image redder, one has to employ either copper or uranium ferricyanide, unless the image is converted into some haloid and again developed. Of these various toning agents the platinum bath for dark colours and the copper ferricyanide for warm colours are the most satisfactory.

A sulphocyanide toning bath, similar to that used for prints, may be employed to tone a warm-coloured image, but the colour of the slide, if toned too far, becomes purplish black, and it is questionable

whether such a colour looks well in a lantern slide. "Photographic purples," as they have been described, are best confined to silver prints, as the instances in which they suit the subject rarely occur in lantern slide work.

The following formula may be used when a sulphocyanide toning bath is wanted:

Ammonium sulphocyanide	...	60	grains
Gold tri-chloride	... ...	5	„
Water	... ...	16	ounces

The gold should be dissolved in half the amount of water given, and the sulphocyanide in the remaining half, the solution of gold being added slowly to the sulphocyanide solution, stirring this all the time.

Some form of platinum bath is a very good toning agent for lantern slides, though a mixture of gold and platinum behaves even better. It should be noted that potassium chloro-platinite is the particular salt recommended, and not platinum bichloride. This latter salt is often quite acid with hydrochloric acid, and requires neutralising first with some alkali and then reacidifying with nitric acid. If potassium chloro-platinite is used no trouble will be experienced.

I have found that the formulæ usually given for platinum toning baths are too weak, requiring an inconveniently long time before any marked change is effected. The following bath is much more concentrated than usually recommended, but gives very good results in my hands.

Potassium chloro-platinite ...	5	grains
Gold tri-chloride	5	„
Hydrochloric acid ...	10	minims
Water	5	ounces

Platinum toning, if carried very far, intensifies the image slightly, so that should an attempt be made to tone a red coloured slide quite black the slide might be found worthless on drying from the adventitious opacity acquired in toning. The most suitable slide for toning is one devoid of any great shadow masses, and one which wants just a little additional density to make it a perfect slide.

The following modification of the gold-platinum bath is very convenient, as with it the increase of density is scarcely noticeable:

Sodium phosphate	50	grains
Gold tri-chloride	5	„
Potassium chloro-platinite ...	5	„
Water	5	ounces

This bath must be used fresh, and will not keep. Toning with it is very rapid, but a pure black colour is not readily procurable.

Toning slides from black to warm is less easy than the foregoing, as considerable intensification follows, besides the alteration of colour. Copper toning appears to give better results than uranium, as the staining of the gelatine previously referred to when speaking of uranium toning does not take place. Mr. Ferguson, who has done a large amount of experimental work in copper toning, recommends

ten per cent. solutions of copper sulphate, potassium ferricyanide, and neutral potassium citrate. To prepare the toning bath we take:

Cupric sulphate (ten per cent. solution)	140 minims
Potassium ferricyanide (ten per cent. solution) ...	120 „
Potassium citrate (neutral) (ten per cent. solution)...	4 ounces

The potassium citrate is added to the copper sulphate, and then the potassium ferricyanide is poured in, when a clear green solution results, which keeps well and tones readily, without staining, from purple-black to red.

Uranium toning is less satisfactory than copper owing to its liability to stain. As, however, beautiful results can be obtained with careful working by the process, I do not feel justified in excluding it from notice. The exact strength does not seem of much importance, a stronger solution merely working quicker. The following is a convenient strength:

Potassium ferricyanide ...	5 grains
Uranium nitrate	5 „
Acetic acid (glacial) ...	1½ drams
Water	2 ounces

After toning, the slide is washed in running water for about ten minutes. Care has to be taken not to wash too long, otherwise the brown colour is washed out, leaving the image in a very unsatisfac-

tory condition. Uranium-toned slides should be varnished when dry to prevent fading.

Although I cannot recommend uranium toning for lantern slides, especially to an inexperienced worker, I must add in its favour that I have obtained excellent slides by its employment, and slides that have undergone no change when protected from the air by being varnished.

A very pleasant bluish-green colour may be given to a lantern slide that has been toned brown with the uranium toning bath if it is well washed and immersed in the following:

Hydrochloric acid ...	...	20 minims
Iron perchloride solution ...		10 ,,
Water	...	5 ounces

The colour obtained is very suitable for foliage subjects, but as the gelatine is stained throughout the slide any subjects with masses of high lights do not look well. The green colour, however, can be discharged from any portion of the slide by treating it with a weak solution (say twenty per cent.) of ammonia. Thus, the sky portion, where the stain shows most objectionably, can be cleared. Again, a slide, having been toned brown with uranium, can have certain portions of it toned green by applying with a camel-hair brush the iron solution given previously; in this way a slide in two colours results, and some subjects look very effective when done in this manner.

In spite of the variety of results that can be obtained by toning methods, I would urge upon the lantern slide worker to devote all his care to gaining a high-class slide by the unsophisticated process of development.

Reducing and intensifying methods are of greater importance than toning formulæ. However expert and careful one may be, a certain proportion of his work will always be the better for readjustment in one direction or the other. Either some portion of the slide is over dense and requires reduction locally, or the whole slide would be better for just a trifle more opacity. Lantern slides, unlike negatives, require their opacity to be exact, or the effect when they are projected upon the screen is unsatisfactory.

The reducer introduced by Howard Farmer is particularly useful in slide work if not used too strong. One and a half grains to the ounce is quite strong enough, though for local reduction of dense portions this may be slightly exceeded. The most convenient way of making up this reducer is to keep a ten per cent. solution of the potassium ferricyanide made up and to add ten or twenty minims of this to each ounce of water. The amount of hyposulphite left in the film and upon the surface of the plate when it is removed from the fixing bath is quite sufficient to effect reduction, though after reduction and a good rinse the plate may be replaced in the fixing bath for some minutes with advantage.

INTENSIFYING SLIDES.

A good lantern plate with suitable developer should, on being removed from the fixing bath, show perfect freedom from any surface marks or deposit, except that which forms the image. Occasionally, when developing for warm colours, an irregular white deposit occurs on the film. This may be removed by washing and rubbing slightly with a tuft of cotton wool, but the ferricyanide reducer is much simpler and safer. A weak solution is flowed over the plate two or three times, just long enough to remove the deposit without reducing the image.

A reliable intensifier is especially useful when making slides having warm colours, as these slides are not easy to obtain of the exact density. The following formulæ may be relied upon to give perfectly satisfactory results without the least influence upon the colour:

A.	Hydrokinone	20	grains
	Citric acid	20	„
	Distilled water	20	ounces
B.	Silver nitrate	20	grains
	Nitric acid	5	minims
	Distilled water	20	ounces

Equal parts are taken to form the intensifier. The plate should be well washed after fixing and placed for some minutes in an alum bath, and again well washed before intensification. As the intensified slide when dry is somewhat denser than it appears when wet, allowance must be made for this

and intensification stopped somewhat short of the required degree. The plate is rinsed thoroughly under the tap after intensifying and placed in the fixing bath for a short time to remove any silver chloride that may have been precipitated in the film.

Another intensifier of considerable value to the lantern-slide maker is that of MM. Lumière. The formula is:

Sodium sulphite	...	1¼	ounces
Mercuric iodide ...	...	30	grains
Water	...	6	ounces

The slide on leaving the fixing bath is well rinsed and flowed over with the above intensifier when density soon accrues. After a good washing, the slide is redeveloped with some developer such as amidol, etc.

CHAPTER V.

CLOUDS IN LANTERN SLIDES—NEGATIVES WITH CLOUDS ALREADY EXISTING IN THEM—CLOUDS BY THE "COVER-GLASS" METHOD—BY VIGNETTING IN THE CAMERA.

LANTERN slides without clouds, where such are necessary, are now as rarely seen as are prints without them. At the present time the percentage of landscape negatives that do not show clouds in them is small indeed compared with what it was fifteen years ago. The orthochromatic plate, coupled with the use of a light filter, makes the retention of clouds in landscape negatives an easy matter; and when even these are not used, the fact that nine-tenths of the exposures made are shutter exposures accounts for the greater prevalence of clouds in the negatives of to-day.

The lantern-slide worker, more than any other, should make a special effort to obtain his negatives with clouds in them, for by so doing he will obviate a large amount of subsequent work. Perhaps in his landscape negatives clouds already exist, but owing to their greater opacity they do not show well defined in the print; in such a case the sky portion should be carefully reduced with ferricyanide

or persulphate until the clouds assume an opacity of equal printing value with the landscape portion. In some cases the sky portion of the negative exceeds in density the landscape portion by only a small amount, and it is not desirable to interfere with the opacity. Where this is the case the landscape portion should be screened during exposure, when making the slide, so that the denser sky may have a few seconds' additional exposure.

There will, however, always be a certain proportion of slides which necessitate the introduction of clouds from other negatives, so that it is essential for the slide maker to be proficient in the methods whereby clouds are introduced into slides that show no trace of them.

Two methods are generally available: the clouds may be printed on a separate lantern plate from a specially made cloud negative, and this cloud slide used as a cover glass; or they may be printed on the same plate as the landscape portion in the camera by double printing. These two methods will now be described in detail, preference being given to the first, or "cover-glass method."

It is essential that the slide maker, who has the prospect of much landscape work before him, should be well stocked with cloud negatives of every description, specially taken and developed, so that he can at any time select a suitable cloud effect for any particular landscape. I recommend that prints from these cloud negatives be mounted in a rough

album, and the time of day when the negative was taken, with the compass direction of lighting, be written underneath. There will then be no danger of *bizarre* and contradictory cloud effects being shown on the screen. In these cloud negatives no portion of the landscape should show; if it is impossible to avoid obtaining some portion when taking the nega-

Fig. 4.

tives the landscape should be blocked out by gumming some non-actinic paper upon the reverse side of the negative.

Having obtained a lantern slide of the landscape portion (fig. 4), see that the sky part of the slide is represented by absolutely bare glass. If the negative has its sky portion blocked out this will secure perfectly clear glass in the lantern slide, but should any deposit be apparent in the slide it must be cleared away by the application of the ferricyanide reducer, applied with a small tuft of cotton wool. The slide is washed and dried in the usual manner.

To make the cloud portion, take another lantern

Fig. 5.

plate, and, having selected a suitable cloud negative make a lantern slide of this (fig. 5). The cloud negative must be adjusted in the camera so as to occupy the position on the plate that will enable it to fit in the clear portion of the landscape slide when the two are bound together. To make this adjustment all that is necessary is to hold the landscape slide over the image of the cloud negative shown on the focussing screen, when it will be seen at once if the two correspond. Expose and develop, taking care to work under the same conditions as when making the landscape so that the colours of both may be the same.

On removing the plate from the fixing bath and comparing it with the landscape portion it will at once be seen how nearly they correspond with each other.

Here, now, is seen the value of reduction and intensification in slide work. Perhaps the sky slide requires a slight intensification to bring it up to the landscape portion, or it may be denser and require a brief application of the ferricyanide reducer. Having made the two slides of equal opacity, place them back to back, with the edges of the slides even. It will at once be apparent whether the two dovetail into each other, or whether the sky slide overlaps the landscape slide and gives a bad effect. Should the sky slide encroach on the landscape anywhere, take a tuft of cotton wool, dip it in the ferricyanide reducer, and, still holding the

slides back to back, carefully remove the portion of the sky slide that overlaps the landscape. Do not use the reducer too strong, and see that none of the reducer reaches the landscape slide by capillary attraction.

When the slides are dry and bound film to film the sky and landscape portions should fit and form a perfect slide as fig. 6.

Fig. 6.

This is the best method of obtaining clouds in lantern slides; but it has one drawback, when

developing for warm colours it is not always easy closely to match the two slides. For this reason it is best, whenever possible, to expose the sky and landscape plates one after the other and develop them together. Another means of ameliorating the difficulty is to prepare a stock of sky slides during leisure moments, so that some variety may enable the slide maker to effect a match.

The second method, that of printing the clouds on the same plate as the landscape, is not quite so certain as the method just described. Having selected the cloud negative it is desired to incorporate with the landscape, a mask has to be prepared with which to screen the landscape portion during the exposure of the cloud negative. To prepare this mask take a piece of non-actinic paper, lay it over the landscape negative, and, holding the negative up to a strong light, roughly trace with a pencil on the paper the outline of the landscape where it comes against the sky. Cut out the landscape portion along this line so that two masks result, one for the sky and the other for the landscape. For convenience, the landscape mask may be gummed on a piece of cardboard, leaving the outline of the landscape projecting beyond the stiff edge of the cardboard. The stiffening is an advantage, as it enables the mask to be held more securely by the hand during exposure.

Place the landscape negative in the camera and expose on the lantern plate in the usual manner.

Then remove the landscape negative and insert the cloud negative, taking care that it is placed in the same relative position that the landscape negative occupied. Now hold the cardboard mask in front of the cloud negative so that it covers that portion of the negative corresponding to the landscape negative. The mask requires holding about an inch away from the negative, and should be kept moving slightly above and below what would be considered to be the line of junction of the landscape and sky portions. It will thus be seen that the sky negative is vignetted into the landscape portion in the camera, so that both are obtained upon the one lantern plate. A little practice enables this to be done in a very neat manner, but this method is probably not so easy for the beginner as the one previously described.

It should be borne in mind that the same necessity exists in this second method for obtaining the landscape portion with the sky showing as clear glass, otherwise on removing the landscape negative and inserting the cloud negative a brilliant result will not be obtainable. If the sky portion of the landscape negative is not sufficiently dense to give freedom from deposit in the slide, that portion of the paper mask covering the sky should be roughly placed in position during the exposure of the landscape negative to ensure this end.

CHAPTER VI.

RETOUCHING LANTERN SLIDES—COLOURS—SPOTTING — VARNISHING — MASKING — SELECTING MASKS—MAKING MASKS—BINDING SLIDES WITH COVER GLASSES—DISCS FOR MARKING SLIDES.

BEFORE lantern slides have the finishing touches put to them in the way of spotting and binding, it is a wise course to put them through the lantern as they are when dry, and ascertain beyond doubt that the density and clearness entitle them to rank as finished slides. The constant and experienced worker can gauge with certainty the quality of his slides without seeing them projected, but the intermittent worker, especially during his novitiate, may well be excused if he fails to appraise correctly the quality of his slide. It entails very little trouble, as the slides can accumulate until a convenient quantity has been made to make it worth while arranging the lantern, and once the slides are seen to be satisfactory when projected, the lantern-slide worker is spared the annoyance of finding that he has finished and bound up a worthless slide.

Before masking and binding the slide, it should be placed on a retouching desk and carefully examined by transmitted light for defects. Of course, before making the slide the negative will

have been carefully spotted and all possible defects removed as neatly as can be, but in spite of this, the lantern slide will require attention at the spotter's hand for defects that have made their appearance during its manufacture. As a rule, the most that can be done in the way of retouching to a lantern slide is the removal of transparent spots by filling up with colour. Knife work, or any process that disturbs the surface of the film, is inadmissible, as, unless most skilfully done, it shows unpleasantly on the screen. It is possible, in certain cases, to rub down dense portions with methylated spirit, in the same manner as is usual with negatives, but the instances when such a procedure becomes necessary do not often occur, and are principally those in which it is absolutely necessary to make the best of a slide from a poor negative.

Spotting should be done by the aid of a very fine camel-hair brush and colour. The precise colour will depend on the colour of the slide, but Indian ink and crimson lake will, either singly or combined, match nearly all slides. A reading glass of low power is of very great assistance in enabling the operator to apply the colour neatly to each spot. Furthermore, no light should reach the lantern slide from the back of the operator, or he will fail to judge correctly of the density of his spotting, and find when the slide is shown on the screen that all the spotting shows up darker than the transparency. The colour should be kept of slightly less density

than the opacity of the slide, and to ensure this being so no light should reach the operator except that which is transmitted *through* the slide. The colour should be used in quite a viscid condition, and tube colours are better than dry, as the menstruum used in their preparation gives them a good working consistency.

As a rule, lantern slides on commercial gelatine plates are not varnished, nor does there appear to be much necessity for varnishing them, as the film, unlike collodion or collodio-bromide, is not liable to be damaged readily by friction. Varnishing certainly introduces the risk of applying specks of dirt and hairs to the film along with the varnish; on the other hand, if it is well done with a clean, hard varnish, immunity is secured from fungoid growths, which not infrequently make their appearance on gelatine films, however well defended and carefully stored. Personally, I always varnish a slide of excellent quality, more especially when it has caused me considerable trouble to prepare.

The following varnish has been spoken of in high terms for varnishing lantern slides:

Saturated solution of amber in chloroform	...	...	1½ ounces
Pure benzole...	...	...	1½ „
Gum dammar	...	...	¼ ounce

When dissolved filter several times through cotton wool. Just warm the plate before varnishing, and dry well over a gentle heat afterwards. It gives a

bright glass-like surface which is quite hard and does not become tacky.

A convenient and reliable varnish is made by dissolving one part of dammar in twenty parts of benzole. This is applied without heating the plate, and dries with a brilliant hard surface. It is advisable in varnishing lantern slides to return the surplus varnish from the plate to a second bottle fitted with a filtering funnel and cotton wool; by so doing a stock of well filtered varnish is always maintained.

Selecting a suitable mask for any particular slide is a matter that must be left to the personal taste of the worker. It is, however, not quite the simple matter it looks at first sight. Time was when a rigorous conventionality assigned a perfect circle as the only possible shape for a lantern slide mask, then dome-shaped and cushion-shaped masks began to be seen, until at the present time the decision is left very largely in the hands of the slide-maker.

It may be said that, generally speaking, lantern slides should be amenable to the same reasoning and rules that good taste and culture apply to the framing of pictures. The slide mask is, to all intents and purposes, the frame of the picture, and its shape should vary with the subject in the same way that the frame of a picture is made to do. Rectangular openings will always be in better taste than cushion or dome-shaped openings, and their dimensions should be proportioned to the subject, a very useful all-round size being a rectangle with an open-

ing of 2⅞in. × 2in. Circles are useful, but of limited application, though for many scientific subjects they are invaluable. Commercial masks are, naturally, of stock sizes, and a well assorted selection of shapes will enable the worker to select one that will suit some subject better than it would another, but not infrequently subjects will present themselves that demand a specially cut mask to frame them most satisfactorily, and the lantern-slide worker must needs become his own mask cutter.

The quickest and neatest way in which to make masks of any desired dimensions for odd subjects is to cut strips of varying widths from the best black needle paper. A supply of these strips may be cut for stock, of standard widths, say, half inch, one inch, one and a quarter inches, etc. The strips are afterwards cut up into lengths of three and a quarter inches, the size of the lantern slide. With a supply of these strips, cut accurately, it is a very simple matter to make a rectangular opening of any dimension by simply affixing them to the slide with a touch of gum arabic, or any other adhesive that may be convenient. A pair of compasses will enable the several strips to be placed equidistant, so that on completion the opening is perfectly true. This method is very much better in all ways for the amateur mask-cutter than attempting to cut a rectangular opening in a sheet of paper.

The masks should be affixed to the film side of

the slide with a touch or two of gum, and then placed under even pressure to become set in a perfectly flat condition. If when making the slide the negative is placed in the camera with its film towards the lens, the lantern slide, when looked through with its film towards the spectator, will

Fig. 7. The completed slide, spotted and mounted.

show the subject in its correct position. Before mounting the cover-glass with the slide, the title may be neatly printed on the black mask with Chinese white, utilising the top of the mask for the purpose. On placing the slide in the lantern, if the

title written in Chinese white be placed towards the condenser the picture appears the right way about on the screen. If the title cannot be written in white on the mask, owing to the negative being reversed when the slide was made, the slides must bear white spots to indicate their correct position—a method described further on.

The cover-glass having been cleaned and placed in position upon the slide, the slides have now to be bound together with the gummed strips sold for the purpose.

Binding a slide is one of those apparently easy photographic operations that is a perfect nuisance until some dexterity has been acquired. Vices, to hold the slide and cover-glass firmly together while the gummed strips are being affixed, may be obtained from the dealers, and they probably help the beginner, but later on he will certainly find that his fingers are his best friends.

The gum strips are sold either cut to the length of the slide, three and a quarter inches, or in sufficient length to bind around the whole of the slide at one operation. For the beginner, the divided lengths are certainly the more convenient. Four of these strips are taken, the gummed surface *damped* (not made wet) with a sponge and placed aside for a few minutes, gummed side uppermost, on a piece of thick felt cloth. The slide and cover-glass are now taken between the index finger and thumb of each hand, and their lower edges placed

in the centre of the gummed strip, downward pressure on the soft felt surface sufficing to attach the strip firmly to the lower edges of the slide and cover-glass. On being reversed, so that the edges bearing the gummed strip come uppermost, the strip can be pressed into contact with the sides of the slide and cover-glass by the forefinger and thumb of each hand. The remaining sides of the slide are bound in the same manner. This is the simplest manner known to me of binding lantern slides, and I have tried a great variety, both with vices and without.

Some years ago the Photographic Club introduced a system of marking lantern slides to facilitate their being placed in the lantern so as to show correctly on the screen; it consisted of affixing two white discs of paper to the slide, on the side that gave the subject its correct rendering as regards right and left-handedness when viewed as a transparency. These discs are placed at the top of the slide when it is held upright. If the slide is placed in the lantern with these discs down and towards the condenser, the view, or subject, is shown upon the screen correctly as to right and left-handedness. This system of marking lantern slides is now generally adopted, and a finished lantern slide so "spotted" is shown in fig. 7 (page 59).

CHAPTER VII.

PREPARATION OF GELATINE CHLORO-BROMIDE EMULSION—FORMULA—METHOD OF MIXING—WASHING THE EMULSION—THE DRYING BOX—PREPARING THE GLASS FOR COATING—COATING THE PLATES.

IN a previous chapter I have said that the preparation of a gelatine emulsion for lantern slides is one of the simplest of photographic operations when the routine of the process has been mastered. It is a fact that the preparation of an emulsion suitable for transparency purposes is far simpler than the making of a high-class slide upon plates coated with the emulsion, yet few photographers question their ability to produce the slide; though the number that have ever attempted to do so upon plates of their own manufacture is no doubt much smaller still.

The making of a lantern slide emulsion is a very different matter from preparing a highly sensitive negative emulsion, where coarseness of grain and fog dog one's steps at every turn. With a lantern emulsion boiling may be dispensed with, and owing to the acidity of the solutions, fog cannot possibly trouble the manipulator except by his own colossal carelessness. My belief that most lantern slide workers would find the pleasure and interest of slide making greatly increased if their plates were

prepared by themselves must be my excuse to advanced emulsion workers if this chapter seems unnecessarily elementary.

The first batch of emulsion ever made by the writer was for lantern slides; it was a complete success, and the slides made from it are still among the finest gelatine slides I possess. This was fifteen years ago, and though I have made gallons of emulsion since then, this first ten ounces of my novitiate, made in a discarded marmalade pot, was as perfect in its way as any of them. This much for the encouragement of the timid. Should the practical minded enquire as to the cost, I may state that, omitting the question of labour, the price of plates for lantern size in my hands works out at about 3s. 6d. a gross.

The formula here given for the emulsion, which I have used for years, is due to the late W. K. Burton; it gives slides of exquisite colour and clearness, and is most simple to make. Although Burton makes no mention of filtering the gelatine before emulsifying, nor of using distilled water in washing the emulsion, I find an unquestionable gain from both practices.

The gain is in clearness of high lights: slides on these plates almost equalling collodion in their absence from anything approaching deposit in their bare glass.

The quantities given will make about ten ounces of emulsion, coating a gross of plates:

A CHLORO-BROMIDE EMULSION.

A.	Nelson's No 1 gelatine ...	40	grains
	Ammonium bromide ...	125	„
	Sodium chloride	25	„
	Hydrochloric acid ...	3	minims
	Distilled water	5	ounces
B.	Silver nitrate (dry) ...	200	grains
C.	Drescher's gelatine ...	200	grains

The gelatine in A is soaked in the distilled water until soft, when the other ingredients may be added and the whole placed in a saucepan of water and heated to a temperature of 140° F. I find a pyro bottle well washed out a convenient vessel in which to perform this operation, as it stands the heat well. When the gelatine has melted, the temperature of the solution should be ascertained by means of a bath thermometer; if less than 140° F. the solution should be raised to that point.

Now comes the operation of emulsifying, which consists of adding the silver nitrate to the bromised gelatine, and this must be done in the dark room. The two hundred grains of silver nitrate, on a piece of clean paper, are taken in one hand, the bottle of hot bromised gelatine, minus the cork, in the other; the crystals of silver are slipped decisively from the paper into the bottle, the cork quickly replaced, and the contents vigorously shaken until all the crystals are dissolved, which may be judged by their ceasing to strike against the sides of the bottle. It is wise to continue shaking the bottle for some time after the crystals are judged to have dissolved.

On removing the cork from the bottle a creamy emulsion will now be found in place of the clear bromised gelatine. This is, of course, the sensitive combination resulting from the mixture of the bromide and chloride with silver nitrate, and it must always be remembered by the novice that the moment bromide and silver are mixed together the mixture becomes highly sensitive to any except the usual dark room light. If some of the emulsion just prepared be spread on a strip of glass and examined either by daylight or by a gas flame, it will be found of a deep ruby colour by transmitted light, and when a thin film of it is magnified by means of a focussing glass or low power magnifier, the granules of silver bromide will be found extremely minute. This indicates a satisfactory state of things, as fineness of grain and ruby colour are essentials in these emulsions.

The emulsion as it now is will be very slow, requiring an exposure in the camera, when reducing by daylight from a half-plate negative, of half a minute to three minutes according to the colour required. If greater rapidity is wanted, the emulsion may be poured into a small gallipot with a light-tight covering, put back into the saucepan, and the water kept at boiling point for five minutes.

I myself have never found it necessary to do this, and recommend the beginner in emulsion work to rest content with the rapidity obtained by simply mixing the solutions at a temperature of 140° F.

After mixing the emulsion it may be left to cool down to about 70° F., and whilst this is taking place the gelatine C (which should have been placed to soak in several ounces of cold water at the time it was weighed out), after having as much of the water squeezed from it as possible, should be melted and filtered several times through cotton wool, cooled down to about 70° F., and thoroughly well mixed with the emulsion.

The emulsion now being completed, it requires to be left until thoroughly set before washing operations can be undertaken, and if it is convenient to defer this until the next evening the emulsion is simply set aside in a light-tight gallipot for twenty-four hours, when it will be in a splendidly firm condition for squeezing and washing.

Washing an emulsion is usually regarded with considerable abhorrence by amateur emulsionists, but if the plan I recommend be adopted it will be found a sufficiently simple operation. A piece of "scrim" about twelve inches square is procured, and the dressing thoroughly removed by washing in soda and water; a clean vessel, which may be an ordinary pie-dish or pudding-basin, holding about a pint, is filled with distilled water and the lump of well-set emulsion having been turned out of the jar and placed in the scrim is forced through its meshes into the water by continuously twisting the scrim round and round, the ball of emulsion being held in the water as the threads of emulsion are forced through

the meshes. Leave the emulsion soaking for about fifteen minutes, then spread the scrim over a clean porcelain developing dish about whole-plate size, and pour into it the water and emulsion from the basin, fill the basin again with distilled water, carefully lift up the scrim supporting the emulsion, squeeze as much water as possible from the emulsion, *without exerting sufficient force to send the emulsion through*, however, and suspend the emulsion in the basin of water, carefully separating the threads of emulsion with the hand so that the water has free access. Give the emulsion three changes of water at intervals of, say, fifteen minutes, squeeze it once again into clean water, and collect on the scrim laid in the developing tray as previously described.

The emulsion may now be considered effectually washed; in fact, I have repeatedly tested the last water from emulsions washed in this manner and have never yet found an appreciable trace of bye-products present. As much water as possible must now be squeezed from the emulsion by twisting it up in the scrim and exerting a gentle pressure on the ball of the emulsion, which will force out the superfluous water without sending the emulsion through the meshes. Collect the emulsion in the gallipot with light-tight cover, and remelt it in a saucepan of hot water, taking care that no light can possibly reach the emulsion. When the emulsion is thoroughly remelted, add to it half an ounce of absolute alcohol and one grain of thymol or carbolic

acid, though if the emulsion is to be used up at once the antiseptic is not required. Filter the emulsion whilst thoroughly hot through a tuft of cotton wool placed loosely in a funnel and it is ready for coating on to the plates.

The amateur plate-maker will probably find it more convenient to coat the exact size of plate he requires in preference to coating plates six and a half inches square and cutting them to size afterwards, though this latter method saves a considerable amount of work. A drying box of some description is a *sine quâ non* in emulsion work, and where lantern plates only are prepared it need be but of the simplest form.

I was assured, when taking up emulsion work years ago, that unless I could make it in quantities of a gallon or two and dry the plates in a properly constructed room with a system of hot water pipes and other luxuries, I had but a small chance of success, and though I have experienced the ease and comfort of working with such a plant when making considerable batches of large-sized plates, I have never found that the plates themselves were any better than could be prepared with the aid of home-made appliances and batches of emulsion as small as twenty ounces.

Having procured the drying-box, the final operation is that of coating the plates. When received from the dealer the glasses require thourough cleaning previous to coating, and the simplest way of

doing this is to rub them over while held in a plate vice with the following mixture:

Common whiting	...	...	2 ounces
Methylated spirit	...	...	2 „
Liquor ammonia	...	...	2 drams
Water	...	...	2 ounces

Apply with a tuft of soft rag or flannel, set aside until dry and polish off with clean linen dusters. For coating the plates, a small Japanese teapot answers admirably, and a piece of plate-glass, about twenty-four inches square, will be required upon which to place the plates when coated until set sufficiently firm to be reared upright and placed in the drying racks. This setting glass requires very accurate levelling by means of wooden wedges before coating is commenced. The emulsion having been melted and poured into the teapot, a plate is taken on a pneumatic holder, and a pool of emulsion about half the area of the plate is poured into the centre of it. This is quickly flowed to the upper right and left-hand corners and returned to the pot by way of the lower left and right-hand corners.

If the emulsion is of the proper consistency, it should flow as easily as collodion, and the covering power of the emulsion being quite exceptional, the thinnest film only is required, consequently the bulk of the emulsion poured upon the plate is returned to the pot, the plate being quickly restored to a horizontal position and deposited upon the levelled

slab to set. In cool weather, and with the emulsion properly prepared, the plates set firm in a few minutes, so that by the time a dozen have been coated the first are ready to place in the drying box. Opening the box before the plates are dry is a mistake, as so doing causes variation in temperature and produces drying marks on the plates.

CHAPTER VIII.

GELATINO-CHLORIDE PLATES—THEIR CAPABILITIES AND PREPARATION—FORMULA FOR EMULSION—CITRO-CHLORIDE EMULSION FOR PRINTING-OUT LANTERN PLATES—PRINTING AND TONING CITRO-CHLORIDE PLATES.

GELATINO-CHLORIDE plates, the preparation of which is the subject of the present chapter, are of the greatest interest to the lantern-slide worker from the remarkable ease and certainty that accompany their preparation, no less than from the great variety and beauty of the results obtainable on them. As is well known among physicists, silver chloride is capable of a most extensive range of tints—a fact emphasised by Carey Lea's classical experiments on this substance. It is not surprising, therefore, that pure silver chloride plates should be of great service to the photographer in search of a lantern plate that will give him readily, either by development or by subsequent treatment, almost any tone he may desire.

Compared with bromo-iodide, or even with the slow bromo-chloride mentioned in Chapter VII., a pure chloride emulsion is extremely slow, but the slowness is largely compensated for by the remarkably fine grain of the emulsion, with its corresponding richness of colour. To improve the speed of

the plates, the emulsion may be boiled, but as boiling increases the grain of the emulsion and tends towards the production of black tones, I strongly recommend that chloride plates should be assigned a distinct place in the economy of lantern-slide production, which is that of contact printing for the production of warm colours, to be subsequently toned or not at the inclination of the maker.

Where a plate is wanted for making slides by reduction in the camera of a warm black or brown colour, it is much better to use chloro-bromide that has been already described. Another argument against the extensive adoption of chloride plates is the fact that their keeping qualities are greatly inferior to those of a pure bromide or chloro-bromide plate, silver chloride plates being strongly addicted to decomposition by keeping, with the formation of an iridescent film. Hence it is injudicious to make anything like a supply of these plates for stock purposes.

In spite of the drawbacks of slowness and instability, chloride plates will always be attractive to the lantern-slide maker by reason of the wide colour range already referred to, with the additional recommendation to the amateur emulsionist of requiring but little care or trouble in preparation.

Their sensitiveness to the spectrum is almost wholly in the violet and blue, so that a very luxurious light can be employed, both in the making of the emulsion and in the development of the plates. In fact, it is quite possible with these plates

to conduct the entire operations of emulsification and development by an unprotected gas flame if it is turned down considerably and the work is conducted some distance off, but this illumination is not to be advocated, especially to the novice, and even the practised worker will find that a canary yellow screen with plenty of light is more pleasant to work by than dodging the direct rays of an unfiltered gas flame.

Many formulæ for chloride emulsions are to be found in the pages of photographic periodicals and handbooks, but I regard most of them as being unnecessarily elaborate. Though I have used several of them, I have never found any material advantage over the simple formula below.

It seems to be immaterial which chloride is used, though some authorities give the chloride of one metal, some that of another, and some a combination of two or three. The following formula is due to Sir William Abney, and is very convenient where the rapidity conferred by boiling is desired. Of course, it will be understood that the apparatus and operations for chloride emulsion making are identical with these described in Chapter VII. for bromo-chloride emulsion, but it is not necessary to be nearly so particular with regard to the light. Plenty of light, filtered through a single thickness of canary medium, may be employed.

A GELATINO-CHLORIDE EMULSION.

Sir William's formula is as follows:

I.—Sodium chloride ...	...	80	grains.
Nelson's No. 1 gelatine		30	„
Hydrochloric acid	...	5	minims.
Water ...	...	1½	ounces.
II.—Silver nitrate ...	...	200	grains.
Water ...	...	½	ounce.
III.—Nelson's No. 1 gelatine ...		30	grains.
Water ...	...	1	ounce.

The above are made into solutions, and in the dark room II. and III. are mixed at a temperature of about 100° F. No. 1 is then added a little at a time, with constant stirring. This may best be performed by mixing II. and III. first in a small jar holding about ten ounces. I. is then poured in from a glass flask in a fine stream, while a constant stirring of the mixture in the jar is kept up with a glass spatula. On the entire emulsification having been performed, a drop is examined by transmitted light, when it will be found to be a bright orange colour, and so fine that the grain is barely discernible with a short-focus magnifier. By reflected light the emulsion is very white. It may now be boiled for fifteen minutes, when it will be sufficiently rapid to permit of camera exposures being made. After boiling the emulsion is cooled down to about 70° F., and 240 grains of a mixture of hard and soft gelatine dissolved in two ounces of water are added. The quantity of gelatine here given by Sir William Abney seems to me excessive, and is probably an

uncorrected error. I add instead 140 grains of hard gelatine.

The formula I use myself for chloride emulsion is here given because of its simplicity. I find it excellent for contact printing, and, of course, it could be made rapid enough for camera exposures by giving it ten or fifteen minutes boiling after emulsification:

A.—Gelatine (Drescher's)	...	80 grains.
Hydrochloric acid (ten per cent. solution)	... ...	20 minims.
Ammonium chloride	...	15 grains.
Water	...	3 ounces.
B.—Silver nitrate	...	40 grains.

Heat the solution A in an amber-coloured flask* to about 140° F., and drop the silver nitrate into the chlorised gelatine, quickly replace the cork, and shake vigorously until the crystals are dissolved. This makes a very fine emulsion, and is an extremely simple method, as the emulsion requires merely to be turned into a gallipot to set, when it may be washed.

Subsequent operations are the same for chloride as for bromo-chloride emulsions, and the reader may refer to Chapter VII. for details of washing the emulsion and for coating and drying plates.

One difference pure chloride plates have from bromo-chloride when coated is that the emulsion is perfectly transparent, and it might be thought that

*By using an amber-coloured flask to emulsify in, the operation can be conducted by the illumination of a bats-wing burner somewhat lowered

density was not obtainable with such a plate. Further, the novice would say that if ever backing were necessary it would be so with such a plate. Experience will prove both impressions to be wrong, however, for chloride plates readily give ample density, and backing is absolutely unnecessary, owing to the extremely non-actinic colour of the emulsion.

By forming an organic salt of silver simultaneously with the chloride, an emulsion may be prepared that will enable the image to be printed out by daylight, as with P.O.P. papers, the transparencies being toned by any of the toning baths recommended for this class of paper.

It will be seen what a scope for variety of tone this process offers to the experimental lantern slide maker, a further advantage being that, owing to the formation of a visible image, clouds are readily introduced by double printing, while any of the "dodges" for improvement during printing customary in paper printing can be applied here with equal facility.

Sir William Abney appears to have been the first to suggest the use of citro-chloride emulsion in gelatine, and the formula given by him will answer all the requirements of the lantern-slide worker. The preparation of the emulsion is even simpler than that of a pure chloride, as it can be made by a naked gas flame, and the thorough washing necessary for a chloride emulsion may be dispensed with.

1.—Sodium chloride	... ...	40	grains.
Potassium citrate	... ...	40	„
Water	... ...	1	ounce.
2.—Silver nitrate	... ...	150	grains.
Water	... ...	1	ounce.
3.—Gelatine	... ...	320	grains.
Water	... ...	3½	ounces.

Nos. 3 and 2 are mixed together, and then an emulsion formed by adding No. 1 in the usual way when forming a gelatine emulsion. When set, the emulsion is squeezed through canvas, as before described, into cold water, and, after allowing it to remain in the water for ten minutes or a quarter of an hour, dissolved. Sir William recommends the addition of three drachms of alcohol and two grains of chrome alum in two drachms of water, but I find they can be omitted without in any way impairing the quality of the emulsion. Should a granular appearance be noticed in the emulsion after mixing it may be boiled for a few minutes, as directed for the bromo-chloride in Chapter VII., when the granularity will disappear, but, of course, the rapidity is somewhat increased. The gelatine mentioned in Sir William's formula is Autotype, but as I am not sure whether this make is now procurable I substitute equal parts of Nelson's No. 1 and Drescher's, which answer perfectly.

Printing these citro-chloride plates may offer some difficulties to those unaccustomed to such work from the impossibility of seeing the image. A tolerably accurate estimate of the depth to which

printing has progressed may be formed by opening the back of the frame and looking at the plate by light transmitted through both negative and plate. A better plan is to attach the chloride plate to the negative by a strip of paper gummed down one side. This forms a hinge, and the plate can be lifted to examine progress and replaced with perfect register. Another plan that may be employed is to coat some paper with the same emulsion as is used for the plates, select a negative of the same density as the one that is to be used with the plate, and expose it under the paper simultaneously with the lantern plate.

As with prints, so with slides. A considerable amount of over-printing is necessary to compensate for the reduction that occurs in the toning and fixing baths. Sulphocyanide toning may be used for these citro-chloride plates, and the formalin toning bath published by myself (*Photography*, Vol. XIV., September 25th, 1902, page 655) answers admirably.

CHAPTER IX.

THE DEVELOPMENT OF GELATINO-CHLORIDE PLATES—DEVELOPERS FOR BLACK TONES—FERROUS-CITRO-OXALATE DEVELOPER—TONING CHLORIDE PLATES—INTENSIFYING—REDUCING.

THE variety of colour obtainable in a gelatino-chloride plate by development was referred to when treating of the preparation of the emulsion. The colours obtainable range from a pure black through browns to a rich warm sepia, and even to bright red and purple, should such be deemed desirable. In addition to the colour range, chloride plates possess a clearness in the high lights and general crispness of image that make work with them a considerable pleasure.

In discussing the various developers applicable to chloride plates, the difficulty is to deal selectively with the immense mass of formulæ.

It may be said at the outset that good black tones with absolutely clear glass are not so readily procured with chloride plates as with chloro-bromide, or, better still, very slow bromo-iodide plates. Nor is it difficult to understand why this is the case. Silver chloride so readily assumes a red colour that one may feel justified in regarding this as its normal colour, and I find that with any form of developer chloride plates so readily develop warm colours that

it is better to retain them exclusively for this class of slide. Black colours demand for their production, as has already been pointed out, a brief exposure to light, followed by energetic development. Both of these factors are difficult of achievement with a chloride plate, the first owing to the want of rapidity, and the second from the liability of the plate to fog if too strong a developer is used. If the best results are to be obtained on chloride plates, forced development must be carefully avoided, or degradation of the high lights will certainly be produced.

For black tones I have used with much success the newly-introduced reducer, edinol, and am inclined to think that it produces a purer black than any of the modern forms of reducers.

Edinol.—For Pure Black Tones.

Edinol	15	grains
Sodium sulphite	120	„
Potassium carbonate ...	60	„
Potassium bromide ...	4	„
Water	4	ounces

Used as the formula here stands, a black colour of great vigour is produced when plates prepared by the second formula given in the last chapter are given a brief contact exposure (two seconds) to diffused daylight. By diluting the above developer with an equal bulk of water a greyish black is obtained, without any of the tendency to green so frequently apparent when trying for black tones.

The image quickly appears, and density is got in much less time with chloride than with chloro-bromide.

An olive-black of great beauty seems to be characteristic of amidol when used with chloride plates.

Amidol.—For Olive-black Tones.

Amidol	20	grains
Sodium sulphite	240	„
Potassium bromide ...	10	„
Water	10	ounces

In spite of the variety of recently introduced developers, the finest results with chloride plates are to be got when using ferrous-citro-oxalate, and my advice to any worker with chloride plates is to confine his attention wholly to this form of development. Mr. A. Cowan traversed the ground of experimental work with ferrous-citro-oxalate development so thoroughly some years ago that his formulæ still stand as the best of their kind.

Ferrous-citro-oxalate.—For Cold Tones.

No. 1.—Potassium citrate ...	136	grains
Potassium oxalate ...	44	„
Hot distilled water ...	1	ounce

For Warm Tones.

No. 2.—Citric acid	120	grains
Ammonium carbonate	88	„
Cold distilled water ...	1	ounce

For Extra Warm Tones.

No. 3.—Citric acid	180	grains
Ammonium carbonate	60	„
Cold distilled water ...	1	ounce

DEVELOPING CHLORIDE PLATES.

To three parts of either of the above add, just before use, one part of the following:

Ferrous sulphate	...	...	140 grains
Sulphuric acid	...	...	1 minim
Water	...	...	1 ounce

The time of development is, of course, governed by the colour sought after, No. 3 being most protracted, but in any case development is much quicker than with chloro-bromide plates, and when obtaining warm tones with chloride the image has none of the "buried" appearance so familiar with warm-coloured images on bromide plates. It will be observed that the formulæ given contain no bromide, the amount of citric acid being sufficient to ensure absolute immunity from any deposit in the bare glass portions. Should the plates at any time show a tendency to fog, a few drops of a ten per cent. solution of sodium chloride to each ounce of developer will keep the film clear. When using No. 1 formula for black tones I find it useful to add one grain of potassium bromide to each ounce of developer, which keeps the development under control, besides ensuring a freedom from fog. The plates should be well washed between development and fixing.

By mixing No. 1 with No. 2 in varying proportions almost any desired colour can be obtained. Thus, two parts of No. 2 and one part of No. 1 will give a fine, warm brown, and it is much more satisfactory to get the exact colour in this way than to resort to after treatment.

TONING CHLORIDE PLATES.

Owing to the ease with which red tones are obtainable on chloride plates, they lend themselves to the after operation of toning far more readily than do slides by other processes, and while giving it as my opinion that the best slides are those requiring no subsequent treatment, I have obtained such satisfactory results by toning red-developed plates that I do not feel justified in excluding toning operations from all notice. Slides for subsequent toning should possess the red colour shown by a paper print before toning, and, of course, should be well washed from the hypo bath.

Practically any of the toning formulæ recommended for chloride papers are applicable to slides, but the toning action is slower, so that the bath may be considerably concentrated with advantage. As with prints, so with slides, a reduction in depth takes place on toning, so allowance must be made for this by developing somewhat beyond what would be necessary for a slide destined to remain untoned. With a platinum toning bath the reduction is very considerable.

Where it is desired to tone a foxy red slide to pleasing shades of brown, the following toning bath is excellent, but toning must not be carried too far, as the slides dry up considerably colder in colour than they appear when wet.

Sodium phosphate ...	10 grains
Gold chloride	1 grain
Water	1 ounce

TONING CHLORIDE PLATES.

If toning proceeds too quickly the bath may be diluted with an equal bulk of water.

By far the best toning bath, however, is the one given below, which contains platinum, and I have every confidence in it, for it has behaved admirably in my hands. With it the slide tones gradually and evenly from a foxy red through browns to a warm black, beyond which stage it is not advisable to go, as the warm black becomes an unpleasant bluish-black.

Sodium phosphate	5 grains
Gold chloride	1 grain
Platinum tetrachloride ...	1 „
Water	1 ounce

No reduction of density takes place in the slide when using this bath, nor is there any great alteration in colour on drying.

Sulphocyanide toning baths readily tone chloride plates, but are not to be recommended, as they give an unpleasant purplish colour to the slide.

Reducing and clearing chloride lantern slides may be performed by the aid of the ferricyanide formula given in Chapter IV. for chloro-bromide plates, but it must be diluted with an equal bulk of water, or its action will be too rapid. A much better reducer for chloride plates is thiocarbamide used as follows:

Thiocarbamide	10 grains
Nitric acid	1 minim
Water	1 ounce

The reduction with this solution takes place quite

slowly and evenly, without any alteration of colour.

There is one method of improving a weak slide, which has at the same time a toning action, leaving a very pleasing result; it is the application of Lumière's mercury iodide intensifier for a very short time. I have obtained some really fine results by giving slightly under-developed slides a brief application of this solution; the mercury wonderfully improves the colour of a red slide by toning it to a warm brown. This intensifier is equally commendable for gelatino-chloro-bromide slides, and I have used it for toning wet plates. The formula is:

Sodium sulphite	1¼	ounces
Mercuric iodide	30	grains
Water	6	ounces

The sulphite is first dissolved in the water, and then the iodide. Plates after intensification are well washed and redeveloped with any such developer as amidol, metol, etc.

CHAPTER X.

COLLODIO-BROMIDE — THE PYROXYLINE — PRECIPITATED PYROXYLINE—NESBIT'S FORMULA FOR EMULSION—MAKING THE EMULSION—WASHING AND DRYING THE PELLICLE—PREPARING THE GLASS FOR COATING—FORMULA FOR UNWASHED EMULSION—PRESERVATIVES.

PERHAPS no particular process in existence possesses the variety of formulæ that the collodio-bromide does. To read up its literature is enough to make any worker forswear it as a process, from the difficulty he would experience in deciding which one was a really suitable formula. The history of the process, however, is not shrouded in the same ambiguity. Its origin was due to Messrs. Bolton and Sayce in 1864.

In its original form, the by-products were washed away after the plate was coated, but a later improvement of Mr. Bolton's consisted of washing the bulk of the emulsion and redissolving the dried pellicle. Both methods have been popular in the past with collodio-bromide workers, and numberless formulæ exist for either process, the mere recital of which would occupy several such chapters as these.

For the sake of completeness, I shall include here a formula for each process, leaving the choice of methods to the taste of the photographer, merely

observing that the formula for washed emulsion (Mr. J. Nesbit's) has enjoyed an exceptional popularity amongst lantern slide workers, to which its simplicity and fine quality fully entitle it.

The first consideration in collodion emulsion processes is the supply of pyroxyline. To make pyroxyline even on the small scale necessary for batches of collodion emulsion would be an injudicious proceeding for the lantern slide worker, owing to the care and specialised knowledge demanded in its preparation. The only satisfactory way for the small consumer is to procure the most suitable cotton some reliable house can supply for the purpose. Fortunately, emulsion processes do not demand such extreme niceties in the preparation of the cotton as does collodion for wet-plate work. One of the best means of procuring a cotton of sound quality for emulsion work is to obtain a good commercial sample, dissolve it in cheap solvents, and precipitate it in water. The cotton thus prepared gives a particularly bright and limpid collodion, the improvement in quality being well worth the slight extra trouble involved in its precipitation.

To prepare precipitated cotton, take 400 grains of ordinary commercial pyroxyline and dissolve it in equal parts of methylated alcohol and ether, ten ounces of each; the specific gravity is not of much importance. Let the collodion thus prepared stand for a couple of days, then filter it through muslin. Pour the filtrate from a height of two or three feet

in a thin stream into a vessel of cold water, stirring vigorously the while. The result of this is to precipitate the cotton in a spongy mass, which must be well washed with several changes of water, pressed as dry as possible in a clean cloth, and carefully dried in a hot water bath. Thus prepared, any ordinary commercial pyroxyline will give a cotton capable of producing satisfactory emulsions.

The formula for preparing a washed emulsion is as follows:

A.—Pyroxyline	60	grains
Alcohol (methylated) ...	2¾	ounces
Ether .730 (methylated) ...	2¼	„
B.—Ammonium bromide ...	63	grains
Water	100	minims
Alcohol	1	ounce
C.—Silver nitrate	100	grains
Water	60	minims

The pyroxyline is first dissolved in the alcohol and ether, then the ammonium bromide is dissolved in the hundred minims of water, heat being applied if necessary, and the alcohol added. This bromide solution is added little by little to the collodion (A) with vigorous shaking. The silver is now dissolved in the given quantity of water by the aid of heat, and in the darkroom added to the bromised collodion a little at a time with constant shaking. A creamy emulsion is the result, having a deep ruby colour by transmitted light. This emulsion should now be set on one side for twenty-four hours to allow

of its ripening, and when this has taken place it is poured into a clean porcelain tray to allow the solvents to evaporate previous to washing. When the pellicle has so far set that it can be torn into firm shreds with a glass spatula, it is broken up into small pieces and put into a suitable vessel filled with cold water, the water being frequently changed for about twelve hours.

On the conclusion of washing operations the pellicle is collected in a clean cambric handkerchief, and as much water as possible is discharged by twisting the pellicle into a firm ball. It has now to be dried. My own way of doing this is to cover the pellicle twice with absolute alcohol, and though the late W. B. Bolton condemned this method of drying, I have found it perfectly satisfactory and simpler than drying spontaneously, or over a water bath. Of course, the alcohol used in desiccating the pellicle can be employed again in other directions, as the amount of water it abstracts is quite small, and can be largely removed by potassium carbonate. As the amount of emulsion made according to the above formula will prepare a large number of plates, the cost of drying by alcohol is quite inconsiderable, and is recommended on account of its ease and simplicity.

The pellicle being now thoroughly dried, it has to be redissolved in a mixture of four ounces of alcohol, with four of ether. It is unfortunate for amateur emulsionists that the alcohol methylated

with wood spirit is not now easily procurable in small quantities, as at the present time one must either employ rather an expensive alcohol, or run the risk of impairing the quality of an emulsion by using the mineralised spirit.

In my own work I use absolute alcohol 800°, costing about 3s. 6d. per pound, and methylated ether of 730°, but I feel sure that it would be possible to prepare an emulsion with a *good* quality mineralised spirit without lowering the quality of the emulsion in any marked degree.

Having redissolved the pellicle in the above mentioned quantities of solvents, all that remains to be done before coating plates is to filter it through cotton wool loosely placed in a glass funnel, covering the funnel with a piece of glass during the operation to prevent as much as possible the evaporation of the solvents. To prepare the plates for coating they are first washed in hot soda and water, then rinsed, and placed in an acid bath, sulphuric acid one ounce, water ten ounces. From this bath they are well washed under the tap until the water drains off in a perfectly even manner, and when the surplus water has run from the plate it is flowed over twice with the following solution, which should be well filtered:

Gelatine	...	...	... 120 grains
Chrome alum		...	... 5 „
Water	...	...	... 20 ounces

The coated plates are placed upright in a rack to

dry, taking care that no dust settles on them.

An hour or two before coating the gelatinised plates the collodion emulsion is well shaken; the object of doing this some time previous to coating being to allow any coarse particles that may be present to settle. A pool of emulsion is poured upon the centre of the plate, flowed around as in the wet collodion process, and the surplus returned to a separate bottle for refiltering, the plate being gently rocked to prevent the formation of "crapey" lines. When set it may be placed in the drying box used for gelatine plates, to become perfectly dry, or it may be placed on a shelf in a light-tight cupboard, as drying occupies but a short time.

The plates from this emulsion will be found very slow for camera exposures, and though "organifiers" are not often used in conjunction with washed emulsion, they are to be recommended if the plates are to be used in the camera, from the additional sensitiveness they confer. Prepare a strong solution of freshly ground coffee and filter it. When the plate has been coated with the emulsion place it in a dish of distilled water, wash it until all greasiness has disappeared, then flow over it several times the solution of coffee, and set it upright to drain and dry in the usual manner.

To those who prefer an unwashed emulsion the next formula may be commended. It has given the writer great satisfaction, and the colour of the transparencies when a coffee preservative is used is a

very nice warm brown. Of course, the designation "unwashed emulsion" is not strictly correct, and may mislead the novice. The by-products are removed just as much in the case of an "unwashed" emulsion as they are in the case of a "washed," but in the one case they are removed by washing the mass of emulsion, and in the other the plates are coated with the emulsion still containing the by-products, and these are washed away from the coated plates. It will be thus seen that by employing an unwashed emulsion the drying of the pellicle and subsequent redissolving are done away with.

If it is asked, wherein does the washed emulsion possess any advantage over the unwashed, it may be answered that, with the latter, unless used up at once, the by-products are liable to affect the sensitiveness and quality of the emulsion. In the case of the washed emulsion no such deterioration need be apprehended, and the emulsion remains in perfect condition for a long time, so that a supply is always at hand from which to coat what plates may be wanted. And it may be mentioned here that it is better to coat a limited quantity of plates and use them up within a reasonable time than to convert the whole stock of emulsion into plates sufficient to last for a year or more.

The formula for an unwashed emulsion is:

Pyroxyline (precipitated)...	24	grains
Zinc bromide	38	„
Ether (methylated) ...	2½	ounces
Alcohol (absolute) ...	1½	„

AN UNWASHED EMULSION.

To sensitise the above thirty grains of silver nitrate are dissolved in the smallest quantity of water possible, and two drams of boiling alcohol added.

This is emulsified into the bromised collodion in the manner already described under washed emulsion. It is now set aside to ripen for twenty-four hours, when it is ready for coating on to the plates. The plates require the same previous treatment of cleaning and gelatinising as already described.

Coating the plates with the emulsion is of course done in the same way as with the washed emulsion, but when the emulsion has set on the plate it is placed in a tray and well washed in running water for about five minutes, when it is taken out, flooded several times with the coffee preservative already mentioned, and placed in the drying box.

CHAPTER XI.

DEVELOPMENT OF COLLODIO-BROMIDE PLATES—EIKONOGEN FOR BLACK TONES—PYROGALLOL FOR WARM TONES—CLEARING COLLODIO-BROMIDE SLIDES—TONING BATHS.

BEFORE the development of a collodio-bromide plate takes place it should be given a preliminary soaking in a bath of alcohol and water (equal volumes of *absolute* alcohol and water, or undiluted *proof* spirit) to make the film sufficiently pervious for the developer to act upon it. Development may be effected by holding the plate in the hand, as is done with wet plates, or it may be placed in a dish, as is done with gelatine plates.

The development of a collodio-bromide plate occupies an intermediate place between that of a gelatine and a wet plate. The image appears quicker and density is obtained sooner with the collodio-bromide than with the gelatine plate, but both are much slower than with a wet plate. Owing to development being under such perfect control, the practice of the collodio-bromide emulsion process will be found to be very valuable as an introduction to wet-plate development, in which the appearance of the image is followed so rapidly by full density that the leisurely gelatine worker rather has his breath taken away.

DEVELOPERS FOR COLLODIO BROMIDE.

Many formulæ may be used for developing collodio-bromide plates—ferrous oxalate, practically any of the modern reducers (such as metol, amidol, hydrokinone, etc.), and, perhaps best of all, pyro and ammonia. It must be observed that as collodion emulsions fog under the developer more easily than gelatine, any developer used must be considerably weaker than would be the case if used for gelatine.

Lantern slides upon collodio-bromide plates have a good range of tone—from pure black to cherry red—depending upon the duration of exposure, but the colour most readily got and eminently characteristic of a good collodio-bromide slide is a warm brown, which, in my opinion, is the one most suitable for lantern slides. If the formula for "unwashed" emulsion given in the last chapter is used, considerable modification of colour can be effected by a selective choice of preservative. Coffee favours the production of warm brown colours, tannin or gallic acid red tones, while albumen and beer are said to yield "grass-green" tones, though I am unable to speak from personal experience on this point.

For the production of black tones, I have used with much satisfaction an eikonogen developer made as follows:

Sodium sulphite	...	...	185 grains.
Potassium carbonate		...	77 „
Eikonogen	...	...	46 „
Water	...	...	4 ounces.

DEVELOPING COLLODIO-BROMIDE.

Should the high lights of the slide after fixing show the least veil on placing the slide down upon a piece of white paper, add to the developer a few drops of ten per cent. bromide solution. After soaking the exposed plate in the alcohol bath mentioned above, wash it under the tap until all greasiness has disappeared; then, holding it between the finger and thumb, pour on about one drachm of the eikonogen developer and rock the plate to and fro. The image will quickly appear, and the detail will keep appearing under the developer in a beautifully even manner until full density is obtained. The slide maker who knows only gelatine plates will require to be constantly on his guard at first against attaining excessive density with collodion plates. The image is never lost sight of with these as with gelatine plates, and as in the fixing bath they lose very little of the fictitious density given during development, it is only necessary to carry development slightly beyond what is wanted in the finished slide.

Under-exposure is fatal to success with collodio-bromide, for nothing like forced development is permissible with these plates. The exposure must be such as will leave only the highest lights unreduced when development is finished. Considerable over-exposure can be quite successfully managed by washing off the developer as soon as the detail is out, and gaining density by re-development in the manner described further on.

Alkaline pyrogallol still remains the best all-round

developer for collodio-bromide. The colours with it are perfect, ranging from a warm black to quite a red with prolonged exposure in a brilliant light. Mr. J. B. B. Wellington has given the following formula:

1.—Ammonium carbonate	...	3	drachms.
Potassium carbonate	...	3	„
Sodium sulphite ...	...	4	„
Water to	...	4½	ounces.
2.—Pyrogallol	...	120	grains.
Sodium sulphite ...	...	1	ounce.
Citric acid	...	25	grains.
Water to	...	4½	ounces.
3.—Potassium bromide	...	30	grains.
Water	...	2½	ounces.

Equal parts of each are taken for development.

The developer I myself prefer contains ammonia, and is as follows:

A.—Pyrogallol	...	36	grains.
Sodium sulphite ...	...	108	„
Water	...	3	ounces.
B.—Ammonia .880 ...	...	20	minims.
Ammonium bromide	...	30	grains.
Water	...	3	ounces.

Take half a drachm of each to develop if the plate is held in the hand, more where a dish is used.

The exposure with alkaline pyrogallol will be prolonged to quite three times that necessary for eikonogen, but the colour of the slide will be wholly different—a purplish or warm brown of great beauty.

DEVELOPING COLLODIO-BROMIDE.

If development shows the exposure to have been considerably greater than necessary, wash off the developer as soon as the detail has appeared, and apply the following to gain opacity:

Pyrogallol	...	...	20 grains.
Citric acid	...	...	40 „
Water	...	...	10 ounces.

Sufficient of this to cover the plate is poured into a clean measure, and a few minims of a two per cent. solution of silver nitrate added. This intensifier is then applied to the plate until sufficient density is gained. By this means slides of great excellence may be produced.

The fixing may be performed with potassium cyanide (twenty-five grains to the ounce) or with sodium hyposulphite. Potassium cyanide is rather to be deprecated as a fixing agent, though several experienced collodio-bromide workers advise its use. It is certainly easier to intensify a plate after using cyanide; but, on the other hand, if the application of cyanide continues after the removal of the unaltered bromide the half-tones of the image will most certainly be attacked.

The washing after fixing is a very simple affair compared with that necessary for gelatine plates. Five minutes under running water is ample, and the slide may be set up to dry spontaneously; or, if wanted in a hurry, can be dried over a spirit flame.

With a properly-made emulsion, slides absolutely free from any suspicion of veil in the high lights should be readily procured. Sometimes a slight

opalescence is observable, which disappears if the slide is varnished. Should any veil be apparent after fixing it may readily be removed by flowing over the slide before washing a weak solution of potassium ferricyanide (about one and a half grains to the ounce), sufficient hyposulphite remaining in the film to effect the removal of the fog. A weak solution of iodine followed by potassium cyanide acts in a similar manner, but it is easy to go farther than is desirable when using this reducer from the fact that the extent of the reduction is not at once observable.

A lantern slide made upon a good collodio-bromide plate should be of such fine quality that the mere suggestion of toning would appear as an insult to it, and I believe that all the experts in collodio-bromide work would indignantly repudiate any suggestion of toned slides. But, bearing in mind that the toning of a slide is an article of faith with many workers, I feel compelled briefly to review some methods that have received attention at my hands.

A slide considered too red may be toned easily with platinum and gold, using the formula given in Chapter IV. for toning gelatine slides. A warm brown may be got with ammonium sulphide, using a weak solution made by adding ten or twenty minims to the ounce of water. Some years ago elaborate instructions were given for toning dry collodion plates by the Hill Norris Company. After bleaching the plate in mercuric chloride solution (five per cent. is a convenient strength), it is well washed and placed in:

TONING COLLODIO-BROMIDE SLIDES.

For dark brown and purple tones—

Potassium metabisulphite	½	ounce.
Water	8	ounces.

For red-brown and red tones—

A simple solution of lime water.

For purple tones—

Sodium sulphite	½	ounce.
Water	8	ounces.

The colours obtained by toning dry up considerably darker, and the density of the slide is very much altered by all toning operations. To be in any way successful in toning collodio-bromide slides they must be thin and full of detail, and those which require but little toning to bring them to the colour wanted will be those of the best quality.

In conclusion, let me advise the lantern-slide maker not to rest content with the brief and necessarily greatly abridged description of the collodio-bromide process given in this and the previous chapters, but to follow it up by references to the writings of such men as W. B. Bolton, Sir William Abney, Canon Beechey, etc., who made this process their especial study. Much useful information is to be found in Abney's "Photography with Emulsions," where a large number of formulæ are given with their various merits and demerits fully elucidated.

At the present time I believe no process will give finer lantern slides than this, and it should be in especial favour with the amateur slide maker from the ease and readiness with which all the operations, from emulsion making onwards, are conducted.

CHAPTER XII.

Wet Collodion—Its Capability—Cleaning the Glass—The Collodion—Silver Nitrate Bath—Collodionising and Sensitising a Plate.

TIME-HONOURED before all other processes for the preparation of lantern slides stands wet collodion, by which is meant the use of plates coated with collodion, sensitised in a bath of silver nitrate, and exposed in a moist condition. Few, indeed, of the large army of lantern slide makers have any knowledge of this process, or realise the ease and certainty with which high-class slides can be obtained by its aid.

At the present time the process seems practised solely by some few professional slide makers, though why the private lantern slide enthusiast should ignore its capabilities so steadfastly I am unable to guess. Probably he regards it as less convenient than the familiar dry plate, to which he can turn at any odd moment; more probable still is the fact that the wet plate is not readily available for contact work. This last drawback distinctly militates against its use, and though it can be overcome to a certain extent, one would not be justified in championing the wet plate for contact exposures. Outside this, wet collodion is almost an ideal process for the lantern

slide maker's operations; it is fairly quick, the plates are readily prepared and still more readily developed, while the purity of the high lights is perfection. Finally, it is easier to get a high-class slide with wet collodion than with any other process, once the requisite skill has been obtained. The acquirement of this manipulative skill is the only stumbling block the modern photographer is likely to encounter if he takes up wet plate work for lantern slides, and as it is merely a question of a little patience and practice to acquire such skill, the effort is certainly worth making.

An important factor in success with wet plate work is scrupulous cleanliness in all the operations, commencing with the preparation of the glass. As received from the dealer, new glass usually has a film of greasy matter covering it, which requires to be carefully removed before using it in the preparation of wet plates. The most satisfactory course is to immerse the new glass in a fairly strong solution of common washing soda, scrubbing each surface with a pellet of flannel or similar material; it is then rinsed thoroughly under the tap, and the plates placed in the following bath:

Potassium bichromate	...	1 ounce
Sulphuric acid	... ...	1½ ounces
Water	... ...	12 „

They may be left to soak in this bath as long as is convenient, and when required should be scrubbed on each face, as was done with the soda solution,

thoroughly washed under the tap, and placed in a rack to drain. When drained, dry them on a clean glass cloth, kept solely for this purpose, and polish them with a chamois leather while held in a plate vice. Glass so prepared is, in my opinion, more satisfactorily cleaned than by any preparation of whiting, etc., and, when edged, is in a perfect condition for collodionising and sensitising. Of course, a stock may be prepared and kept ready for use, but as glass laid aside soon becomes coated with a film, it is safer to clean it as wanted, more especially as the trouble entailed is very small.

A collodion film on glass is very apt to slip from the plate at some stage of the operations, unless the surface is prepared in some way that will make it adhere firmly. Many devices have been proposed, each of which has its adherents, but for simplicity and efficacy none are better than an edging of rubber in benzole. A solution of pure rubber in benzole is made, about three or four grains to the ounce, and with a small camel-hair pencil the plate is given an edging about an eighth of an inch wide. This is a certain cure for slipping films, and leaves the plate in its chemically clean condition.

Briefly stated, the chemistry of the wet plate is this: Pyroxyline, dissolved in certain proportions of alcohol and ether, has, added to the solution, soluble bromide and iodide; a glass plate coated with this "collodion" is immersed in a bath of silver nitrate, which at once gives rise to the formation in the

collodion film of sensitive silver salts. After exposure, which takes place upon the removal of the plate from the silver bath, and while it is in a wet condition, the latent image is developed by the application either of an iron or of a pyrogallol solution, more generally the former. The preparation of the collodion, which is the corner stone of successful wet plate photography, is of itself such an important subject that no detailed reference in these chapters would be of any use to the reader, who will be wise to obtain it from some maker of repute, ready iodised, *i.e.*, with the necessary haloid salts already in solution.

Collodion for wet plate transparencies requires to have been iodised for some time, or until it has become sherry coloured from the liberation of iodine. If high-class negative collodion is purchased from a dealer, it will be found to be of a pale straw colour, which colour deepens gradually as time goes on. The better plan is to purchase several four-ounce bottles of collodion, number them with the date of their purchase, and keep them in a cool place to ripen, replacing an empty one by procuring a fresh bottle. In this way a constant supply of "ripened" collodion will be always on hand. If it is necessary to take the new supply into immediate use, the first bottle used may have added to it sufficient tincture of iodine to give it a pale sherry colour.

The sensitising or silver nitrate bath, requires to

be kept scrupulously free from any contamination when once it is made up, for it is soon thrown out of working order by the acquisition of foreign matter. The solution is best kept for use in an upright glass bath enclosed in a wood case with cover, such as is sold for the purpose by photographic dealers:

Sensitising Bath.

Silver nitrate	...	...	400 grains
Distilled water	...	...	10 ounces

The silver nitrate may be any good sample, but there is some advantage in using the recrystallised form. When dissolved, the solution requires to be carefully tested for acidity. Drop into the solution a piece of blue litmus paper; if it slowly turns red the bath may be considered already sufficiently acid. Should it not turn a decided red, then add, very cautiously, drop by drop, with vigorous stirring, sufficient of a ten per cent. solution of nitric acid slowly to turn the litmus paper a decided red. The object is to have the bath decidedly acid, as this condition is necessary to secure plates free from fog.

A freshly made silver bath requires to be saturated with silver iodide before it will give a satisfactory film, and the simplest method of attaining this is to collodionise a plate (in the manner described further on) and leave it in the bath for some hours, when the iodide of silver first formed will be redissolved by the excess of silver nitrate in the bath, and give no further trouble.

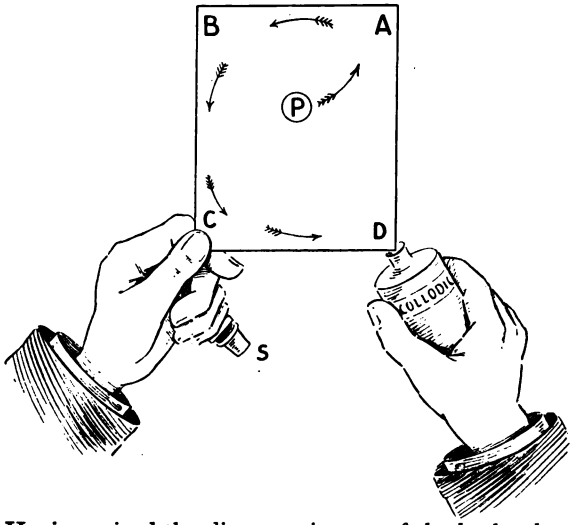
COLLODIONISING A PLATE.

To coat a plate with collodion preparatory to immersing it in the sensitising bath, the dark room should be illuminated with a plentiful supply of yellow light, and the silver bath placed in a position readily accessible, preferably to one side of the non-actinic lamp.

Select one of the cleaned and edged glasses, carefully dust it with a soft brush, and hold it horizontally by one of its corners between the index finger and thumb of the left hand. Take the collodion bottle (collodion is best poured from a specially made bottle known as a "cometless" pourer) in the right hand, and accustom yourself to remove the stopper by using the little finger and palm of the hand holding the plate; pour into the middle of the plate a pool of collodion equal to about a third of the plate's area. Flow this pool ***by very slightly depressing*** the level of the plate, first to A, to B, to C, and then return the surplus to the bottle by pouring off from D. As the surplus collodion is being returned to the bottle, the plate is being ***gradually*** raised towards a perpendicular position, and at the same time a rocking motion backwards and forwards is given, using the corner D as a pivot.

On the completion of collodionising, the plate should present a perfectly structureless homogeneous appearance. When the collodion has ceased dropping from the corner D, the stopper should be replaced at once, and the bottle set aside, the plate meanwhile being held in a perpendicular position. If, now, the tip of a finger be pressed against the

lower edge of the plate, the collodion will be found firm enough to take and retain its impress; this is the condition for its immersion into the silver bath.



Having raised the dipper quite out of the bath, place the plate upon it, and lower both, ***without the least hesitation or stoppage***, right into the bath. If any pause takes place in lowering the plate, however momentarily, a line across the plate is sure to result. The plate is left to sensitise with the cover placed upon the bath for a period of some three minutes in warm to five or more in cold weather.

When sensitising is considered complete, the plate is slowly withdrawn from the bath and reared upright upon a piece of clean blotting paper to drain for some minutes, the surplus silver being removed from the back of the plate with a small pellet of blotting paper.

CHAPTER XIII.

EXPOSURE OF WET PLATES—DEVELOPERS FOR WET PLATES—TONING WET PLATES—CLEARING WET PLATES—BATH DRY COLLODION PLATES—BARATTI'S PROCESS—DEVELOPMENT OF BATH DRY PLATES.

IT is usual in wet plate work to employ a specially made single dark slide for holding the plate during exposure, and if wet plates are to form a permanent feature of one's work, it is well worth the small outlay involved in having one fitted to the camera used for reduction. Should, however, anyone desire to modify his double slide for use with wet plates, this may readily be done by having the necessary inner carrier to take 3¼ by 3¼ plates fitted with either glass or silver wire supports, and coated with shellac varnish. Great care should always be exercised to prevent silver solution from the plate draining into the slide, as such carelessness would soon ruin it. Before putting the well-drained plate in the slide, first place small corners of white blotting paper on the glass or wire supports, and lay the plate carefully on those. The lower thick edge of the collodionised plate should always be kept lowest in all subsequent operations, and once the plate has been placed in the dark slide the slide must be kept upright, with

the thickened edge of the collodion lowest.

Generally speaking, the exposure of a wet plate may be taken as about equal to that of a chloro-bromide lantern plate, *i.e.*, some thirty seconds with f/16, when reducing from a half-plate, with the camera pointed towards a north aspect, and good diffused light, using, of course, some form of iron developer. With acid pyrogallol the exposure would be prolonged some five or six times.

A full exposure is a *sine quâ non* in successful wet plate work, one of the charms of the process being the ease with which an over-exposed plate can subsequently be intensified so as to give a high-class slide if development is stopped by copious washing as soon as the detail is out and before the high lights have been clouded. There is scarcely the tropical exuberance of choice in the matter of wet plate developers that we find among those for gelatine; one has to choose either iron sulphate or acid pyrogallol, and it may here be said for the guidance of beginners that iron sulphate is by far the most convenient.

Developer for Wet Plates.

Ferrous sulphate	20	grains
Glacial acetic acid ...	15	minims
Alcohol	2	drachms
Water	3	ounces

This developer works better if used some days after preparation; if wanted at once, hot water should be employed.

Although this simple form of iron developer works very cleanly, and gives excellent results, the developer I most strongly recommend is that given below. I ascribe it to Mr. E. Dunmore, as it was under his name I first met with it. The slides developed with it have a singular richness and warmth of colour, though care has to be observed against attaining excessive density.

Ferrous sulphate	96	grains
Lump sugar	96	„
Glacial acetic acid ...	3	drachms
Albumen	1	drachm
Distilled water	6	ounces

The albumen is added last, after the other ingredients have been dissolved.

To develop take about two drachms of either of the above solutions in a clean measure, take the exposed plate by the corner held during collodionising, and quickly and evenly sweep the developer along the lower (thick) edge, at the same time slightly inclining the plate so that the developer flows across the plate to the farther edge. A considerable degree of practice and dexterity are required to do this successfully; the developer must not be washed off the plate, or a thin, flat image will result, and it must cover the whole of the plate at one sweep, for the image appears almost at once. Should any part of the plate not be covered, developing marks are inevitable. The density will grow very rapidly under the developer if the exposure has been ample,

and as soon as it is deemed sufficient the plate should be quickly rinsed under a gentle force of water and placed in the fixing bath, which consists of a 1 : 5 solution of sodium hyposulphite.

Excessive density is the error most likely to be committed by the beginner, and he will be wise to err on the side of under-development until he acquires the knack of recognising the exact opacity. A slide destined to be toned afterwards, either by platinum or by sulphide, should have less density given it; it should also be remembered that wet plate slides acquire a slight additional opacity on drying, hence a slide that looks slightly too thin when wet will be exactly right when dry.

The colour of a developed wet plate is not always pleasing, though when the developer contains an organifier, such as is included in the second formula given above, the deposit is of a very agreeable warm black, and quite satisfactory without further treatment.

Many formulæ are extant for toning wet plate slides, the most satisfactory among them being those in which platinum, gold, or ammonium sulphide is employed. Platinum gives a good black, similar to a platinum print; gold a more or less blue-black; while ammonium sulphide gives very fine brown tones. As observed earlier in this chapter, any slide destined for toning should be left rather thin, for all toning operations increase the opacity of the slide. The platinum and gold toning bath

given in Chapter IV. is excellent for wet plates when black tones are required.

One of the best methods for obtaining rich brown tones is to treat the slide first with a weak solution of mercuric chloride (1 : 20), then, having well washed the plate for some minutes, apply the platinum and gold bath. A very weak solution of ammonium sulphide will tone a slide to a warm brown, but with a considerable accession of density, which is not so apparent when the slide is wet as on drying. The bath of sulphide must be kept weak, as its action is very energetic—a few minims to the ounce of water is sufficient.

Mr. Chas. Whiting, who some years ago made wet plate lantern slides an especial study, published his method of obtaining warm tones. He advised that, after fixing and thorough washing, the slide be immersed in a bath of iodine and potassium iodide ("of a port wine colour") until the whole of the image was converted into the yellow iodide. After a good washing, it was placed in a bath of ammonium sulphide ten minims to the ounce of water, when the image became a rich chocolate brown. The colour became still warmer by placing the slide, after thorough washing, in the following bath:

Gold trichloride	1	grain
Potassium ferricyanide ...	60	grains
Uranium nitrate	60	„
Water	20	ounces

Wet plate slides can be intensified or reduced just

as readily as gelatine. If but slight intensification is needed, the application of one of the toning agents given above will probably set matters right, improving at the same time the colour of the slide. Should considerable strengthening be necessary, the slide is well washed after fixing, and the silver intensifier given in Chapter IV. is applied, bearing in mind the fact that the slide will be denser on drying than it appears in the wet state.

Several methods of "clearing" a wet plate slide may be employed. A weak solution of cyanide and iodine is useful, but I fail to see that it has any advantages over ferricyanide if this latter be used weak, say three grains to the ounce. W. B. Bolton advised potassium bichromate as being the best of all reducers for wet plate transparencies. His formula was:

Potassium bichromate	...	1	ounce
Hydrochloric acid	...	1	„
Water	...	20	ounces

A few drops of this stock solution are added to an ounce of water, and the plate after treatment with it is washed and placed in clean hypo. This is a very energetic reducer, and as the extent of its action cannot be realised altogether until the plate has been refixed, it can hardly be regarded as a safe reducer for the inexperienced worker.

Before leaving the consideration of wet plate work mention may well be made of dry collodion plates prepared by the aid of the bath. In early collodion

days it was quickly seen that if the sensitive plate when it left the nitrate bath could be preserved for a reasonable period before and after exposure, a great convenience would be assured to photographers. Taupenot was the first to show how this could be done, and he was quickly followed by many others with formulæ of more or less intricacy. However widely the various formulæ may differ in their details, the essential principle remains the same, which is the application of a preservative to the film on removing it from the bath, the free silver in the film having first been washed away. As the silver bath required for these processes is such a one as will give clean satisfactory images when used for wet plate work, it will at once be apparent that anyone working the wet collodion process can at all times prepare some dry plates with the minimum of trouble. From the large number of bath dry plate processes I have selected one due to Colonel Baratti as being simple and reliable.

Baratti's Preservative Bath.

Coffee (freshly ground)	...	1	ounce
Lump sugar	... ...	½	„
Boiling water	... ...	10	ounces

This is filtered on cooling, and will keep in good condition for a week or ten days. Collodionise and sensitise the plate, as would be done for wet plate work, and on removing it from the bath wash it in distilled water to remove the free silver, then either flow the preservative over the plate, or, which is

better, place it in a dish, and cover with the solution. On removing the plate from the preservative bath, set it on edge to drain, and then let it dry spontaneously in a drying box.

The exposure for these plates will be considerably in excess of that needed for wet plates, probably five or six times more, and the plates should be backed before use. Having exposed the plate, remove the backing, and wash away the preservative in a bath of water at 65° F. For development either iron or alkaline pyrogallol may be employed. Sir William Abney, however, strongly recommends the following formula:

No. 1.—Gelatine	64	grains
Glacial acetic acid ...	2	ounces
Water	14	„
No. 2.—Ferrous sulphate ...	30	grains
Water	1	ounce

The gelatine is swelled in half the quantity of water and dissolved by adding the remaining half hot, the acetic acid being added when the bulk has cooled. No. 1 keeps indefinitely, but No. 2 has to be made up fresh, owing to the iron becoming oxidised. One part of No. 1 is mixed with three parts of No. 2, and filtered. To each drachm of the mixed solution one minim of a thirty grain silver solution (*i.e.*, thirty grains to the ounce) is added just before development. As the image gradually appears more silver solution is added, a drop or two at

a time, until the whole of the detail is seen; the plate is then well washed, and density obtained by flowing over it the following intensifier:

Pyrogallol	...	...	2 grains
Citric acid	...	...	4 „
Water ...	...	...	1 ounce

To a sufficient quantity of this add a few drops of the thirty-grain silver solution. The plates are fixed in the usual sodium hyposulphite bath (1 : 5).

CHAPTER XIV.

CARBON PROCESS FOR LANTERN SLIDES—MOST SUITABLE KIND OF NEGATIVE FOR THE WORK—CUTTING AND SENSITISING THE TISSUE—PREPARING THE NEGATIVE—PRINTING—"BASE" GLASSES—DEVELOPING THE PRINT.

CARBON as a process for making lantern slides seems never to have attained great popularity, although beautiful results are to be obtained by it. The reasons for this neglect lie mainly in the fact that carbon is altogether a process for contact work, and also that it necessitates a very vigorous negative if good results are to be obtained; the soft, flat negatives so customary at the present time quite fail to give satisfactory results in carbon. The ideal negative for lantern slide production in carbon is a stereoscopic negative by wet collodion; from such I have obtained most beautiful carbon slides.

Anyone who possesses quarter-plate negatives that have been over developed and give "brilliant" prints in gelatino-chloride paper may very well employ them for producing carbon lantern slides, and so avail himself of the beautiful colours procurable in carbon tissue. An instance where carbon slides are particularly effective is to be found in wave pictures, which, when printed in green carbon,

are of great beauty, as are also woodland scenes.

The carbon tissue may be bought ready sensitised, but the trouble of sensitising one's own is so small that I strongly advise the home preparation. The tissue when sensitised will keep in good condition, if stored in air-tight tubes, for a fortnight or more, but as there is always more or less tendency for the tissue to become insoluble by long keeping it will be found to work easier if used within a few days of its preparation.

As 3¼ × 3¼ is rather a small size to prepare, I recommend that a strip six and a half inches wide be cut from the band of tissue; this can be sensitised and dried in one piece and cut up afterwards. To sensitise this strip prepare the following bath:

Potassium bichromate	...	1 ounce
Liquid ammonia .880	...	20 minims
Water	...	30 ounces

Immerse one end of the strip in the solution, and gradually and loosely roll the strip up, keeping the unrolled surface under the solution. Having rolled the strip completely, unroll it with one hand while rolling it again with the other, still keeping it under the solution. After rolling and unrolling the strip two or three times it will have become thoroughly flaccid, and may slowly be withdrawn from the solution and pinned up by two corners to dry.

Drying must be conducted in a non-actinic light; if sensitised over night and hung up in a warm room

the tissue will be dry by the following morning. The strip of tissue may of course be cut up before sensitising into squares of six and a half inches, and these sensitised separately.

Having dried the tissue, cut it up into convenient sizes and store flat under a heavy pressure—a printing frame with plate-glass bed answers admirably.

Before printing, the negative has to be prepared with a "safe edge" to prevent the tissue frilling on development. The readiest way of procuring this safe edge is to gum strips of non-actinic paper, about $\frac{3}{16}$in. wide, around the negative on the reverse side. The carbon tissue must be cut rather smaller than the plate it has finally to be mounted upon, to allow for subsequent expansion, *i.e.*, when mounting upon the regulation lantern size, $3\frac{1}{4} \times 3\frac{1}{4}$, the piece of tissue should be trimmed before printing to $3\frac{1}{8} \times 3\frac{1}{8}$, and care must be taken that the safe edge covers this size all round. If, however, the carbon printer can use a diamond, by far the best way is to select four negatives of equal density ($3\frac{1}{4} \times 3\frac{1}{4}$), safe edge each one, and print them all in a whole-plate printing frame upon a single piece of tissue, this being developed upon one "base" glass which is afterwards cut up into $3\frac{1}{4} \times 3\frac{1}{4}$ lantern slides.

There is no visible image in carbon printing, so recourse must be had to an actinometer of some description. As good a one as any is to select

and keep for the purpose some negative of average density, which should be put out to print with a piece of chloride paper at the same time that the carbon print is put out; a little experience will enable the printer to judge of the carbon print by the appearance of the visible silver print.

Carbon printing may be taken to be about double the rapidity of gelatino-chloride, so if the actinometer negative is of the same density as that from which carbon slides are desired, it will be fully printed when the silver is about half finished. Considerable latitude is allowable in printing carbon transparencies, and the niceties imperative in producing paper prints are not here necessary; it is, all the same, desirable to have them somewhat deeply printed to obtain a vigorous result.

Having obtained the print, the next operation is that of mounting it for development upon a "base" glass, which is a plate coated with some insoluble gelatine to retain the carbon tissue during its development with hot water.

Bichromated gelatine is generally used for this insoluble substratum. The Autotype Company's formula is:

Nelson's No. 1 gelatine	...		6 drams
Water	...	...	20 ounces

Soak the gelatine in the water until swelled, and then dissolve by gentle heat. Add ten grains of potassium bichromate. Plates are coated by flowing

them over with this solution, and are then placed in a strong light until dry.

I myself much prefer the chrome alum method. Soak one hundred and twenty grains of hard gelatine in twenty ounces of water, and dissolve by heat, then dissolve thirty grains of chrome alum in one ounce of hot water and add it to the gelatine solution slowly and with vigorous stirring. Coat the plates by flowing on and off, setting them upright in a rack to dry where they will be free from dust. The "base" plates keep indefinitely.

To develop the carbon prints, the printed tissue is immersed face down in a dish of cold water, and the base glass upon which it is to be developed is placed in another dish of water face up. The tissue requires careful watching; gradually it straightens itself perfectly flat, and this is followed by the edges beginning to curl over. Now is the time to place it in the dish containing the base glass, adjust it in position, and lift them both out together, letting the water drain from between the carbon tissue and the glass in such a manner that it leaves behind no imprisoned air bells. Place the plate upon a soft flat surface (a piece of thick felt answers very well), and with a flat (not round) squeegee secure contact between the tissue and glass by working the squeegee from left to right with light even strokes, the finger tips of the left hand being rested firmly on the extreme edge of the tissue to retain it in position. The tissue thus mounted may be left for an hour

before development, to secure firm adhesion to the insoluble substratum.

Development is effected simply by immersion in hot water. The plate bearing the mounted tissue is slipped into a dish containing water of about 100° F., and allowed to rest, well covered by the water until the gelatine is seen to issue from between the plates and the paper in a melted condition; raise the corner of the paper from the glass plate and strip it completely away by pulling it in a diagonal direction across the plate from one corner to the other. The superfluous pigmented gelatine has now to be washed away by the hot water until only the picture remains, which may be expedited by rocking the dish to and fro so as to cause a wave of hot water to operate on the soluble surface. If the picture appears to have been over printed, considerable reduction is possible by using water heated to 110° or 120° F., but some care is necessary to prevent reticulation. When finished, a plucky transparency with absolutely clear high lights should be the result, which merely requires rinsing under the tap and setting aside to dry.

When using freshly prepared tissue, the paper support strips most readily in the hot water used for development, but after keeping some time the gelatine gradually becomes insoluble, and difficulty may be experienced in getting the paper to strip from the glass; in this case only hot water and patience

will help matters. On this account I recommend the use of freshly sensitised tissue.

Another point where the inexperienced may find trouble is when mounting the exposed tissue on the base glass. If the tissue is left soaking too long a time previous to mounting it on the base glass it curls back upon its paper support, and no amount of persuasion will then make it adhere to the glass. The exact time to transfer it to the glass is when it has straightened itself out, and is showing a tendency to curl in the opposite direction.

The great difficulty with carbon lantern slides is to secure sufficient vigour in them, and to attain this end various methods of intensification have been proposed from time to time, but I am not sure that any of them have been very successful from the lantern slide maker's point of view.

The main requisites in the production of good slides are a vigorous negative and deep printing, preferably on tissue specially prepared for transparencies, such as that sold by the Autotype Co. as "Special Transparency" tissue.

CHAPTER XV.

THE ALBUMEN PROCESS—A MODIFIED ALBUMEN PROCESS—PREPARING THE IODISED ALBUMEN—SENSITISING THE PLATES—DEVELOPING AND TONING THE PLATES.

IT is many years now since Ferrier, of Paris, produced the transparencies by the albumen process, which brought him a world-wide reputation, yet even to-day, when one of his productions comes into the hand of the lantern slide connoisseur, its rare quality and beauty of colour commands instant admiration. For many years it was believed that the magnificent results obtained by Ferrier were due to some secret process of his own, whereas the process he used was the one generally employed at that time, and the superiority of his results was due entirely to his manipulative skill.

The albumen process as practised by Ferrier and his contemporaries was troublesome in the extreme, and it is to be doubted whether any modern worker would expend the time and patience necessary to make himself expert in the process. Coating and drying the plate with the iodised albumen required a high degree of dexterity, while the merest trace of dust was fatal to a perfect result. Later on, a modified albumen process came into use, which gave

equally good results with a fraction of the trouble.

The original albumen process consisted of coating a plate with albumen, in which was dissolved the necessary haloid salts, the film being dried over a flame and then sensitised in an acid silver bath, and again dried. The more recent innovation consists of first coating the plate with collodion and then flowing the iodised albumen over this film, the plate afterwards being dried before and after sensitising.

It will thus be seen that the later process partakes quite as much of a collodion process as it does of an albumen one, but it must be confessed that the facility conferred in working by the use of collodion more than recompenses one for abandoning a historic process that, despite its difficulty, gave exquisite results.

The 3¼ × 3¼ plates require to be as carefully cleaned for the albumen process as for wet collodion, and the same method of cleaning them may be adopted. Having cleaned and dusted the plates they are coated with well ripened collodion, the collodion, for instance, that is used when making wet-plate slides. As soon as the collodion has set the plate is immersed in a dish of water, which may advantageously be distilled water. The dish should be rocked gently to and fro until the plate on being removed shows no signs of "greasiness." It is then set up on its corner to drain for a few moments before coating with the iodised albumen.

MAKING ALBUMEN SOLUTION.

The formula for this iodised albumen is as follows:

Albumen	... ...	5 ounces
Acetic acid	... ...	20 minims
Ammonia (.880)	... ...	25 ,,
Potassium iodide	... ...	30 grains
Potassium bromide	... ...	4 ,,
Water	... ...	2 drams

The eggs should be carefully broken into a clean vessel, and the whites separated from the yolks in the manner adopted by cooks. The germs also should be extracted from each egg. About five eggs will be required to yield the above amount of albumen, and although "shop" eggs may be used the albumen is brighter if obtained from newly-laid eggs. Having obtained the five ounces of albumen, quite free from yolk and germs, carefully mix with it the twenty minims of acetic acid, diluted with the two drams of water, given in the above formula. This requires thoroughly incorporating with the albumen to precipitate its proteids, and the best way of doing so is to stir the mixture continuously and gently with a broad strip of glass. The stirring must be continued until the viscidity of the albumen is thoroughly broken up.

The albumen is set aside for about twenty-four hours, after which time the precipitated proteids will be found collected in a thick layer on top of the albumen, and should be carefully removed. The albumen has to be filtered through cotton wool until it appears thoroughly clear and bright, after which

the twenty-five minims of ammonia and the potassium salts are added, and it is ready to flow over the collodionised plate. I prefer to make ready the albumen solution some weeks before it is wanted for use, and then to decant the upper portion and use that. The most careful filtration fails to give such clean albumen as that thus obtained.

The collodionised plate, having been washed and drained as previously explained, is flowed over with the salted albumen, the first application being allowed to drain into the sink, as it is weakened by mixing with the water in the collodion film. A second application is made and flowed to and fro upon the plate to permit of its penetrating the collodion film, when it may be poured into a second bottle and used for the first flowing on another occasion. Having albumenised the plates, they are placed in a rack to drain for about half an hour, and then dried off before a clear fire, or over a hot plate supported above a gas ring. The plates may with advantage be made quite hot when drying them off to lessen the danger of blistering in subsequent operations.

It will be understood, of course, that the process of collodionising and albumenising the plates can be carried out in full daylight, and that the plates so prepared can be stored for any reasonable time without fear of deterioration.

SENSITISING ALBUMEN PLATES.

To sensitise the plates the following bath is prepared:

Silver nitrate	... ...	440 grains
Acetic acid (glacial)	...	1 ounce
Water (distilled)	... ...	10 ounces

The bath should be saturated with potassium iodide by adding to it two grains of iodide dissolved in about one dram of water. This addition causes a turbidity to appear which disappears on filtration. The solution is best used in an upright dipping bath, as recommended in wet-plate work, but it may also be used in the ordinary porcelain dish if care be taken to avoid marks arising from stopping the solution in its first even flow across the surface of the plate.

The time of immersion in the silver bath varies with the temperature, being longer in the winter than in the summer; an average time is one minute. On removing the plate from the silver bath it is drained and placed for several minutes into a dish of distilled water, whence it goes into a dish of common tap water, finally being well rinsed under the tap, the object being to remove all free silver from the film. The plates, after washing, may be dried in the drying-box used for gelatine plates, or they may be simply reared up on a shelf in a light tight cupboard.

It may be advisable to state that a large amount of yellow light can be used in the preparation of

these plates, so that a single thickness of canary medium or good yellow paper is ample protection against fog. Owing to the thinness of the film the plates require backing. If the washing that follows sensitising has been thorough the plates will keep in good condition for several months

Albumen plates are so slow that the exposures have of necessity to be by contact. To diffused daylight the plate may be exposed from a few seconds up to half a minute, according to the density of the negative. Gaslight is unmanageably slow unless a mantle is employed on the burner. By far the best illuminant for these plates is magnesium ribbon burnt in lengths of one inch. If under-exposure is followed by forced development the colour of the slide with albumen plates will be an unpleasant olive-green. To obtain the warm brown so distinctive of Ferrier's slides the exposure must be full and the development quick.

Originally development was effected with gallic acid, and the patient workers of those days frequently expended the greater part of an hour in coaxing a plate up to its full density. More recently pyrogallol has much simplified the process of development.

Having exposed the plate and removed the backing with a damp sponge, it is placed in a dish of distilled water having a temperature of from 100° to 130° F., in which it is allowed to soak for

some minutes. A sufficient quantity of the following developer is measured off—say one dram—and to it is added a couple of minims of a one-per-cent. silver solution. Having drained the plate from the bath of distilled water, the developer is flowed over in the same way as that practised for wet-plate development, when the image quickly appears and gains density.

The developer, it should be added, requires to be of a temperature about 100° F. if warm colours and quick development are desired. Cooler solutions prolong the time of development, and produce colours tending towards greenish browns. Should the developer become muddy before sufficient density has been obtained, it must be washed off and a freshly made solution applied.

DEVELOPER FOR ALBUMEN PLATES.

Pyrogallol	15 grains
Citric acid	5 „
Acetic acid (glacial)	2 drams
Water (distilled)	5 ounces

The temperature of the developer, and the amount of silver nitrate added to it, have a marked influence on the colour of the slide, and it is by attention to these points that the best results are obtained. Fixation of the plate is effected with sodium hyposulphite, 1 : 5.

Albumen slides may be toned after fixing if the colour is not satisfactory. Ferrier is said to have toned his slides in mercuric chloride, followed

by gold, and the following bath has been recommended:

A. Sodium hyposulphite	...	2 ounces
Water	...	6 ,,
B. Gold chloride	...	1 grain
Water	...	2 ounces

The gold solution should be neutralised by adding sufficient sodium bicarbonate, and then *B* added slowly to *A* with constant stirring. The mixed solutions are set aside for several hours to ripen before using, and the bath can be used repeatedly if sufficient gold is added to replace that abstracted by use.

Before toning, the slides require well washing under the tap to free them from the fixing solution, but anything like the prolonged washing given to gelatine plates is quite unnecessary with albumen, and the film may be considered sufficiently washed by allowing it to remain under a running tap for five or ten minutes. Toning proceeds very slowly, requiring perhaps half an hour, but the process may be accelerated by keeping the bath at a temperature of 100° F. to 130° F. It must be remembered that albumen slides dry up darker in colour than they appear when wet, and also that they gain considerably in density.

With practice this will be found quite a simple method of preparing plates for contact use, and when experience has been gained in working the plates it is possible to produce results by this process that cannot be surpassed.

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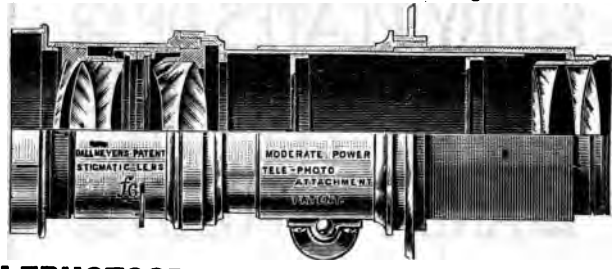

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